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Output of Large Generating Systems

WE PUBLISH in this issue very interesting statistics on the outputs of the large generating systems of this country and Canada, representing approximately two-thirds of all of the central-station energy manufactured in 1917. The lessons to be drawn from the figures are many and varied. One in particular cannot be over-emphasized at this critical time when fuel conservation and important water-power legislation are under consideration at Washington. From time to time the central-station industry has been charged with grabbing all the water power in sight and playing the hog. Certain government officials have maintained that further water-power development was unnecessary because in some sections, particularly on the Pacific Coast and in the Northwest, overdevelopment of water-power resources could be shown. On this point the statistics published throw an interesting light. Facts are stubborn things, and how the facts in this case can be controverted we do not know. We do know that they belie the statements of the water-power obstructionists and that next year more fuel will have to be burned by hydroelectric companies because of the shortage of rainfall this winter on the Pacific Coast. Therefore any relief measures contemplated must be acted on quickly. As indicative of the immense saving of coal possible through the development of water powers, the statistics show an aggregate output of electricity from that source equivalent to the consumption of 25,000,000 tons of coal.

The Wages of Labor and Living Cost

IN THE discussion by L. K. Comstock, published in part in last week's issue and concluded in this issue, we have an earnest effort to perfect a reasonable solution of the labor problem in the electrical contracting industry. It is commended to our readers for the important lesson which it carries. The war is bringing momentous changes to the world. They touch for long-lasting good or ill the relation of massed capital and massed labor and also of individual labor and smaller units of capital. Mr. Comstock admits the issue frankly. His proposition is that it must be solved by intelligent, fair, logical methods, just to labor. Labor's standpoint is like that of the manufacturer whose production cost rises. Living cost of the workingman has advanced, and if he cannot bridge the chasm between that cost and his earning power he faces a bankruptcy that is as perilous to him and to the nation as the bankruptcy of the capital of the manufacturer. Either one threatens a catastrophe which it is our highest interest to avert. Sometimes business men of real integrity voluntarily increase payments under a contract price because they know that higher costs made the performance of the contract impossible at the stipulated figure without damaging loss. Many voluntary advances have been made; more will have to be made if present abnormal living costs and labor scarcity continue. The future will be made easier in the relations of labor and capital if capital, seeing clearly the needs of the hour, shows labor that it proposes to meet them fairly.

The Water-Power Bill

HEARINGS on this important measure are now under way, and we earnestly hope that the facts presented will lead to the rapid passage of the reasonable legislation which can well spring from the bill now under discussion. It would perhaps be impossible to draft a bill to satisfy everybody. Indeed, one of the best criteria of a really equitable decision of any kind is that all of the parties thereto should consider that they had been favored with only a partial victory. In the long run sound compromises can be made which will produce good results, even if not wholly pleasing to everybody concerned. The main thing now is to enact such a statute as shall encourage the speediest possible development of the hydraulic resources of the country. The nation has had a hard time during the past winter in obtaining its necessary supply of fuel; and it is not likely to have an easy time next winter in view of the heavy strain that may be expected on our already burdened transportation systems. Everything that can be obtained from hydroelectric plants is badly needed, and this is no time to temporize concerning the situation or to split hairs over the form of requirements to be embodied in the bill.

The main thing is to give those who would be glad to develop water powers a fair enough chance to hold their interest in the work and to encourage them to go at it immediately. Before the end of the current year it will be possible to put a very large amount of hydraulic power into service provided that the chance is given without further exasperating delays. The fuel situation is not likely to become much easier to meet before the close of the war, whenever that may be, and it certainly is a gross neglect of national resources to permit the continuing loss of valuable power. The obstructionists are in chief those who are attempting to force the government at once into the water-

power business as a national enterprise. The government has already enough on its hands in the necessary assumption of business more immediately concerned with the war to keep any reasonable official body busy to its heart's content. It might with great profit to the country take into its own hands temporarily still other affairs in which it is suffering from scandalous profiteering. In view of all this, and of the fact that the government will have control in the broadest sense of the operations of hydroelectric plants established on its domain, it seems scarcely wise to undertake in its own behalf their full financing and administration. We do not believe that the government is looking for trouble to this extent, and we most earnestly hope that it will give some reasonable encouragement to the conservation of fuel by passing promptly a workable water-power bill.

The Use of Synchronous Motors

THE synchronous motor, although at present used in a somewhat limited way, has certain virtues which commend it to the engineer quite apart from its very useful function in power-factor correction and as a voltage regulator. Its practical field of operations is well described in Will Brown's paper in the current issue, which will be rather an eye-opener to many engineers who do not fully realize in how many instances the synchronous motor has found application. On broad principles the synchronous motor has for its weakest points the need of an exciter for the field and a somewhat limited starting torque. Its strong points are its beautiful uniformity of speed, its power to carry stiff overloads and its generally useful effect on the power factor of the system. In addition, it is a general rule that a synchronous motor has a higher efficiency than an induction motor of the same output, particularly when the rotative speed is low. Hence it is that Mr. Brown shows that synchronous motors are likely to pay for their somewhat higher first cost after a short period of use, simply by reason of higher efficiency. The cause of this higher efficiency is obvious enough in the lessened hysteretic losses and in the lessened I^2R loss when the synchronous machine is used anywhere near unity power factor.

It is on account of the general requirement of an exciter and of a construction which adds considerably to the cost of the machine that it is not usual, as Mr. Brown correctly states, to find synchronous machines used, save for motor-generator sets, for outputs of less than about 100 hp. Above that output the lessened running losses score pretty heavily in its favor. Looking over the list of applications in the paper before us, one is immediately struck with the ready applicability of the synchronous machines to large pumps, either piston or centrifugal. These are quite universally started at light load by the use of by-passes or analogous means, thus overcoming one of the inherent failings of synchronous motors. With recent designs the starting torque has been materially improved, but it is still too low for picking up anything near the rated load. The torque per kva. is also relatively low, but so indeed it is in many induction motors of the squirrel-cage type. There is a general feeling that it is somewhat difficult to start up a synchronous machine. In point of fact this difficulty is popularly rather exaggerated, since with the proper starting arrangements the rotor is quickly brought to speed and very readily synchronized, with only an insignificant chance of anything going wrong. There are, too, a great many kinds of work in which the load can be assumed by a clutch after the machine is at speed.

Air compressors and ammonia compressors in ice plants furnish admirable loads for the use of synchronous machines, particularly on account of the very material gain in efficiency to be secured by their use. In fact, one of the earliest applications of the polyphase synchronous motor was in driving the compressors of an ice plant. It is particularly well suited to this use because these compressors have not infrequently to work at part load and the efficiency curve of the motor can be kept considerably flatter than the normal efficiency curve of an induction motor. When direct-connected drive at low speed is desirable the induction motor is somewhat at a disadvantage, particularly in the matter of power factor. In all cases where a synchronous motor can be used under fairly steady load it stands a chance of getting a power rate bettered by the obviously useful effect on the power factor of the load, and even of the plant. The average power factor of a central station carrying a heavy load of induction motors is none too good even in these days of improved design, and the question of proper charges for the kva. demand required is one that is continually coming to the front. Mr. Brown's paper, with its comprehensive study of various applications, should prove a useful guide in planning for a combined load which will tend to keep up both the power factor and the working efficiency of the system as a whole.

A Simple Method of Measuring Emfs. Accurately

IN MEASURING the emf. generated by a thermocouple, so as to determine the temperature of the same, there is probably no apparatus so reliable as the potentiometer, provided that there is a suitable range for small voltages. In some potentiometers the range of precision in the first few microvolts is too narrow. A disadvantage of the potentiometer is that, being a zero-reading instrument, it takes some little time to adjust the potential for galvanometer zero. When a number of such thermocouples have to be tested in succession this process becomes slow and tedious. A more convenient measuring device in such cases is a millivoltmeter, which on being connected to the thermocouple under test speedily indicates the terminal voltage. If the thermocouple and its leads have appreciable resistance, the drop of potential therein may cause the millivoltmeter to indicate appreciably less than the true emf. It would be desirable to combine the convenience and rapidity of the millivoltmeter with the freedom from drop error of the potentiometer.

Two suggestions toward this object were offered by F. Wenner, P. D. Foote and E. E. Weibel in an article printed in our last issue. These methods lack the precision of a good potentiometer, but they are swift and convenient in operation. The precision available is probably in most cases satisfactory, and there should be no drop error. As adjuncts to the testing laboratory these methods are well worth noting.

Standardizing Factory Lighting

THE considerable increase in night work which has resulted from the war lays particular emphasis on the importance of the artificial lighting of factories. Prof. C. E. Clewell's discussion of the efforts to standardize suitable lighting for industrial establishments therefore has direct value at the present moment. The I. E. S. code of 1915 was a long step in advance and served as a basis for some important legislation. The experience of the last three years, together with the greater amount and severer requirements of factory lighting, has rendered changes desirable. These were undertaken last year by the I. E. S., and their importance has been emphasized by the recent legislation which Professor Clewell mentions. Changes in the original code have been in considerable degree due to the greater importance now attached to artificial illumination and to a considerable degree have been in the direction of a more complete classification of the work to be done. Another very important change has been to direct more specifically attention to the question of glare, always recognized as a very important factor in successful industrial lighting, but hard to reduce to workable definitions. Indeed, whether it is possible to draft a regulation of a kind practicably enforceable which will properly cover the subject of glare is a question which does not yet admit of a definite answer.

A longer step forward is made in the strong recommendation of actual measurements of the lighting by a portable photometer. At the present time instruments of this kind, of sufficient accuracy for the purpose and convenient for use, are readily attainable, and there is no reason why legislation as to industrial requirements cannot be worked to a successful result. The four desiderata in industrial lighting suggested by the committee on labor of the Advisory Commission—to wit, conservation of eyesight, safety, increased labor efficiency and better quantity and quality of output—are the obvious things to be borne in mind in codes and statutes. As regards the general conditions of lighting, those which satisfy the last two requirements will also satisfy the first two, with due attention to the lighting of stairways and other areas of that kind.

If the minimum lighting requirements are specified in accordance with the suggestions of the I. E. S. and can be enforced, as is comparatively easy by the use of portable photometers, the whole situation will be effectively cleared up. Heretofore it has been far easier to say whether lighting was or was not good than to pin it down to definite intensities of illumination. Now, with the problem of photometry somewhat simplified, the necessity of training state factory inspectors in the use of instruments and in the fundamental principles of industrial lighting becomes obvious. At present they will have much less difficulty than was the case a very few years ago, since manufacturers are compelled to do much work by artificial light and have come rather generally to realize at last the importance of good illumination as a factor in the general success of the plant. Very little pressure intelligently applied by legislation and its judicious enenforcement will work wonders.

Increasing the Carrying Capacity of Underground Cables

IN THE electric circuit it is well understood that the difference of electric potential E produced by a direct current I in traversing an electric resistance R is expressed by Ohm's law according to the equation $E=IR$. In a similar way, there is a thermal law like Ohm's law, which states that the difference of temperature, or thermal potential, θ deg. C. produced by a thermal current F traversing a thermal resistance R is given by the corresponding equation $\theta = FR$. In the case of an underground cable the thermal current is determined by the loss of electrical energy in heat, so that F may be regarded as fixed by the electric current carried over the conductor. The temperature elevation which this F can develop depends entirely upon the thermal resistance in the path of its escape to surrounding bodies at normal temperature.

The thermal resistance between the conductor of an underground cable and the remote normal-temperature environment resides in the dielectric envelope, the air space between the cable and the conduit, the conduit walls and the soil in their immediate vicinity, all taken in series. A considerable share lies in the air space within the duct. The resistance in the dielectric and in the conduit walls may not be susceptible of change. What these offer in any given case may have to be accepted. If, however, the duct containing the cable be filled up with some cheap electrically insulating material of better thermal conductivity than air, the total thermal resistance R may be appreciably reduced, thereby reducing the temperature elevation θ of the cable; or, if the cable is thereby kept unnecessarily cool, the original temperature elevation may be retained, with a correspondingly larger electric current and thermal current F.

The article this week by E. O. Schweitzer describes an experiment in which the substitution of crude vaseline for air in a cable duct was found materially to diminish the thermal resistance and corresponding temperature elevation. It remains to be seen whether on a larger scale vaseline is a suitable substance for use in this way; but it is only reasonable to expect that some economical substance should be thus available for replacing air in underground-cable ducts, so as to increase the safe electric carrying capacity of the cable.

The Coming Issues

AMONG subjects which will be discussed in early issues of the ELECTRICAL WORLD will be the relative effectiveness of different methods of measuring internal temperatures in large generators, changing aspects of factory lighting legislation, relative costs of furnishing hydroelectric and steam generator power, increasing economy in boiler rooms, and improving the starting characteristics of synchronous motors. An article will also be published presenting in systematic form, for the convenience of designing engineers, information on different safety features which have been developed for use in connection with switching installations. Lessons arising from the curtailment of lighting will be discussed.

What Synchronous Motors Can and Cannot Do

Discussion of Industrial Applications as Viewed from the Standpoint of Performance Alone—Power-Factor Improvement a Secondary Advantage

BY WILL BROWN
Electric Machinery Company

IN MANY discussions of synchronous motors the subject of power-factor correction and condenser capacity is mixed up with and allowed to overshadow the characteristics of motor performance. A motor should be judged, however, by its ability to perform a certain duty and should stand or fall upon this performance alone. If it is able to improve the power factor of the system, this characteristic may then be considered as an additional point in its favor.

Service That Synchronous Motors Cannot Give

While synchronous motors as now designed are quite different from the modified alternators of older days, and can develop 30 to 50 per cent full-load torque at starting, there are certain duties they cannot perform. So as to clear up any misunderstandings that may exist concerning synchronous motors in regard to either their limitations or advantages, some of the purposes to which they cannot be adapted will be outlined first.

(1) They cannot be used profitably on small loads. This generally means anything under 100 hp. An exception should be made in the case of small synchronous motor-generator sets, however.

(2) They cannot be used on intermittent loads involving frequent starting and stopping, such as crane motors, reversible hoist motors, etc.

(3) They cannot be used where variable speed or adjustable speed is demanded unless some mechanical means of regulating the speed change is provided.

(4) They cannot be used where it is necessary to start up the full load from rest unless a clutch or some other mechanical method of easing the starting condition is supplied.

Uses to Which Synchronous Motors Are Adapted

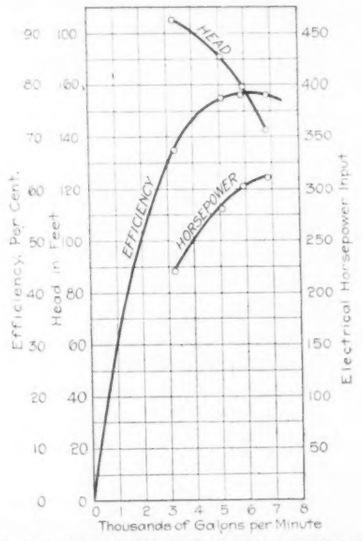
In answer to the question which now probably arises in the reader's mind, "Where are synchronous motors now in use?" Table I is presented. It does not by any means cover the full field of possible applications, but it does indicate the already wide range of these motors and the promise of a much greater use in the future.

Where a heavy and fairly continuous load can be driven at a constant speed, there is generally an opportunity to install a synchronous motor. High efficiency and reliability of service are the two great essentials in such work. It is safe to say that a synchronous motor is always higher in efficiency than an induction motor of corresponding rating. At low speeds the advantage in favor of the synchronous motor is even greater than at high speeds.

There are many heavy-duty machines which must be run at low speeds. Formerly, if these machines were to be driven by motors it was necessary to install some form of belt or gear drive. They can now be directly connected to synchronous motors and operate efficiently at speeds as low at 72 r.p.m.

Starting Ability.—The old handicap of synchronous motors was their inability to start up from rest while carrying a mechanical load. This handicap has been overcome to a greater extent than most engineers realize. There are practical examples of large synchronous motors developing a starting torque as high as 50 per cent of full-load torque obtained without a prohibitively large kva. input. The future will probably bring even more remarkable results.

It is a fundamental fact that a low-speed synchronous motor cannot develop as high an initial starting torque with the same starting voltage as the high-speed motor,



OVER-ALL EFFICIENCY OF DIRECT-CONNECTED CENTRIFUGAL PUMP

it being understood that horsepower ratings of the two motors are the same. For example, a certain motor with a synchronous speed of 200 r.p.m. can develop a starting torque of 35 per cent of full-load torque on the 40 per cent voltage tap with an input of 130 per cent of the full-load kva., whereas a 600-r.p.m. motor can develop a starting torque of 40 per cent of full-load torque on the 40 per cent voltage tap with an input of 115 per cent of full-load kva.

Variable Loads.—Many types of heavy-duty machines requiring variable output are now designed so that they can be started and driven by synchronous motors. For instance, in a certain reciprocating pump installation a variable stroke is automatically obtained by means of bell cranks and by shifting the cylinder. This permits varying the delivery from zero up to 4200 gal. (15,900 l.) per minute.

Mechanical methods for changing the inlet or outlet passages for fans and blowers permit the use of constant-speed motors where formerly only adjustable-

speed motors could be used. There are already a number of such installations—for instance, large exhaust fans such as are used on mine shafts, etc.—and it seems quite likely there will be many more in the future.

Line-Shaft Drive.—In cases where manufacturing processes are so correlated that a line-shaft drive is preferable to individual motor drive, the synchronous motor is finding wide applications. The motors may be either direct-coupled or belted. For this service it is nearly always necessary to use a clutch, either mechanical or magnetic, to permit starting and bringing the motor up to speed before the load is thrown on. The writer knows of a number of installations of this type in flour mills, also in rubber mills, all of them operating very satisfactorily and handling heavy loads, in which there are at times considerable fluctuations.

Efficiency and Ruggedness.—The high efficiency which can be secured with a synchronous motor is well

TABLE I—APPLICATIONS TO WHICH SYNCHRONOUS MOTORS ARE ADAPTED

TYPES OF PLANTS USING SYNCHRONOUS MOTORS AND THE MACHINES WHICH ARE DRIVEN →	AIR COMPRESSORS	AMMONIA COMPRESSORS	CENTRIFUGAL PUMPS	CONVEYORS	CRUSHERS	FANS	FREQUENCY CHANGERS	GRINDERS	JORDANS	LINE SHAFTS	MIXERS	MOTOR GENERATOR SETS	PULP GRINDERS	RECIPROCATING PUMPS	ROLLS	SCREW PUMPS
AUTOMOBILE PLANTS	■					■				■		■				
BRICK AND CLAY PLANTS			■	■		■										
DRAINAGE PLANTS			■													■
ELECTRIC LIGHT AND POWER PLANTS							■					■		■		
FLOUR MILLS										■						
FOUNDRIES	■											■				
ICE AND REFRIGERATING PLANTS	■	■										■				
IRON WORKS	■						■									
IRRIGATION PROJECTS			■													
MINES	■		■			■						■				
MARBLE AND STONE CUTTING PLANTS								■		■						
METAL WORKING PLANTS	■									■					■	
OIL REFINING PLANTS			■									■				
PAPER MILLS									■			■	■			
QUARRIES	■				■											
RUBBER MILLS										■		■			■	
RAILROAD SHOPS	■									■						
SHIPYARDS	■											■				
STEEL PLANTS	■											■				
SUCTION DREDGES			■													
SEWAGE DISPOSAL PLANTS			■									■				■
STONE CRUSHING PLANTS				■						■		■				
TEXTILE MILLS												■				
WATER WORKS			■												■	
MISCELLANEOUS	■	■				■	■			■		■			■	

illustrated in the following installations: One marble-working concern has been operating a 150-hp. synchronous motor driving a line shaft for nearly four years. The choice originally lay between an induction motor and a synchronous motor. The higher efficiency obtained by the synchronous motor brought a saving in the first two years of operation which more than made up for the higher original cost of the synchronous motor.

There is a rather interesting installation in a paper mill where a 1150-hp. synchronous motor is driving two direct-coupled pulp grinders. No difficulty has been experienced either in starting or running. An induction motor of similar horsepower driving a similar load has caused more or less trouble, which is generally traced to the very small air gap. The slightest wear in the bearings alters the air gap sufficiently so that a very heavy magnetic pull is set up on one side of the rotor and quickly wears the bearings down still more until the time arrives when the motor must be stopped and the bearing repaired. Very frequently the windings of the armature are damaged also. The synchronous motor, owing to its comparatively large air gap, is much more rugged and dependable for operation on low-speed, direct-connected loads.

Air-Compressor Drive.—Air compressors, especially those of sufficiently large capacity to require 100 brake horsepower or more, can be economically and efficiently driven by a synchronous motor. The old idea that it was necessary to change the piston speed with change in air demand has been abandoned. Mechanical methods of regulation on the compressors now permit the driving motor to operate at a uniform speed.

In practice synchronous motors are used both belted and direct connected to the compressor. On direct-connected units the speeds required are generally within the range of 260 r.p.m. down to 120 r.p.m. Probably the greatest number of direct-connected synchronous-motor-driven compressors operate at a speed in the neighborhood of 200 r.p.m. This speed is very much higher than was ever thought advisable by compressor builders a few years ago. The increased speed has been made possible by the adoption of a light plate valve with a low lift. The time required to open and close such a valve is so small that it permits operating the piston at much higher speeds.

In starting an air compressor the pressure can be relieved by a by-pass so that the motor has only the friction load and inertia to overcome in breaking the compressor from rest. This is very easily taken care of without drawing excessive kva. from the line, and the motor can pull into synchronism without causing objectionable fluctuation of the line voltage.

Since the load factor of a compressor is generally high, and since the power factor of a synchronous motor can be maintained at unity, a favorable rate can usually be secured when energy is purchased from a central station. The fact that these motors operate at unity power factor or slightly leading (at part loads) should appeal with even greater force to plants generating their own energy. The power factor and efficiency obtained with a typical direct-connected synchronous motor-driven air compressor are shown in Table II.

Recently there has been an enormous demand for large synchronous-motor-driven air compressors among the shipyards of the country. They range in size from 150 hp. to 1200 hp. Among other lines of industries using synchronous-motor-driven air compressors might be mentioned mines, foundries, automobile factories, structural steel works; in fact, any industry where a large quantity of compressed air is used. In driving tunnels the air pressure can be maintained in the headings by means of a battery of low-pressure compressors driven by synchronous motors.

Ammonia-Compressor Drive.—The large ammonia compressors used in ice plants (50-ton or over) are driven in exactly the same way as air compressors, by either belted or direct-connected synchronous motors. The starting duty required is somewhat more severe than in the case of air compressors, however. In order to obtain the required starting torque it is sometimes necessary to use a higher voltage tap on the starting compensator than would be necessary with the corresponding air-compressor installation. The large flywheel combined with the inertia and friction

of other moving parts requires that the motor be specially designed to produce maximum starting torque.

The preference for direct-connected synchronous-motor-driven ammonia compressors is very markedly shown in the ice and refrigerating plants recently constructed or now in course of construction. It may be said safely that the energy cost with direct-connected synchronous-motor-driven machines is less per ton of ice manufactured than is the case with any other type of motor drive.

TABLE II—EFFICIENCY AND POWER-FACTOR TESTS OF 560-HP., 225-R.P.M. SYNCHRONOUS MOTOR DIRECT-CONNECTED TO AIR COMPRESSOR
Exciting current remaining constant at all loads

	Quarter Load	Half Load	Three-Quarters Load	Full Load	One-and-a-Quarter Load
Efficiency	92.6 per cent	95.6 per cent	96 per cent	96 per cent	95.4 per cent
Power factor	73 per cent Leading	93 per cent Leading	98 per cent Leading	100 per cent	98 per cent Lagging

Once it was considered essential, in order to meet the varying demands for ice, that the speed of the ammonia compressors should be adjustable. This is no longer necessary. In place of one large unit running at variable speeds, ice plants can have two or more smaller units which run at constant speed. By running different combinations of the compressors in parallel, fluctuation in demand can be easily cared for without any provision for speed adjustment. When the demand drops to a minimum the smallest compressor only may be used, so the losses may be kept at the minimum. It can be seen that the over-all efficiency of such a plant will be very much higher than in the old-fashioned variable-speed plant.

Another method of varying the output of the compressor at constant speed is by means of an adjustable clearance pocket, or cylinder, at each end of the compression cylinder. By means of these the clearance can be increased and the capacity lowered to any desired point between full load and one-quarter load or even lower. Thus the flexibility of the compressor is fully equal to that of the old adjustable-speed compressors driven by low-speed Corliss engines.

The efficiency curve of the synchronous motors is quite flat throughout a wide range of load, so that there is very little loss in efficiency on the part of the motor when run at part loads. As far as the compressor is concerned, the efficiency at part loads seems to be practically as good as at full load. This is due to the general conditions under which ice-manufacturing plants operate. The efficiency, power factor and starting torque for a typical synchronous-motor direct-connected to an ammonia compressor are indicated in Table III.

TABLE III—EFFICIENCY AND POWER-FACTOR TESTS OF 450-HP., 200-R.P.M. SYNCHRONOUS MOTOR DIRECT-CONNECTED TO AMMONIA COMPRESSOR
Exciting current remaining constant at all loads

	Quarter Load	Half Load	Three-Quarters Load	Full Load	One-and-a-Quarter Load
Efficiency	87.7 per cent	92.6 per cent	93.7 per cent	94 per cent	93.8 per cent
Power factor	70 per cent Leading	94 per cent Leading	99 per cent Leading	100 per cent	99 per cent Lagging

Direct-Connected Centrifugal Pumps.—Quite a number of installations of synchronous-motor-driven centrifugal pumps have been made recently. In most cases the motor is directly coupled (through flexible coupling) to the pump shaft. Starting requirements of a centrifugal pump can be met by a properly designed synchronous motor. Before starting, the pump is primed. The discharge valve is closed when the motor starts, so the impeller merely churns the water. The load increases rapidly, running up to 30 per cent, or even 50 per cent, of full load as the motor approaches synchronous speed. When full voltage is applied and the motor is pulled into step, there is a momentary rush of current, which, however, should not be excessive and should fall almost immediately as the motor settles down to synchronous operation. The maximum peak at pull-in should rarely exceed 150 per cent of the full-load kva.

As long as the discharge valve is closed the impeller is churning the water, and this energy is transformed into heat. If this operation is continued too long, steam might be generated. A small by-pass for liberating air relieves any possibility of steam pressure. Of course the proper thing to do is to open the discharge valve as soon as the motor is running at synchronous speed and allow the pump to begin discharging at its normal head.

There are numerous cases where centrifugal pumps driven by synchronous motors are used for suction dredging. As the pipe lines which carry the discharge are extended from point to point as the dredge continues its work, a large change in the friction head occurs which necessitates two-speed drive for the pump. This requirement can be met by using a two-speed helical gear.* The over-all maximum efficiency of a centrifugal pump directly driven by a 300-hp. synchronous motor is shown in the chart on page 604.

Each installation of centrifugal pumps is a special problem, and both motor and pump must be designed as such if best results are to be secured. Generally speaking, centrifugal pumps are designed to operate at constant speed. Synchronous motors with speeds as low as 72 r.p.m. are used directly coupled to low-head pumps. High-head pumps with speeds as high as 1200 r.p.m., or even 1800 r.p.m., are also directly coupled.

Unity Power Factor Operation.—A synchronous motor designed for so-called unity power factor operation has a fixed exciting current which cannot be exceeded, so that absolutely unity power factor cannot be maintained if the load fluctuates. As the load drops off the power factor will change to leading, but the change in power factor from full load to quarter load is surprisingly small. From one-and-a-quarter load to one-half load the change in power factor is less than 10 per cent. At one-half load the power factor is slightly leading and at one-and-a-quarter load slightly lagging. If the load should be removed entirely from the motor, it would operate at approximately zero power factor up to about one-half of its rated kva. capacity.

*In one plant using this drive which the writer inspected the energy cost was only five-sixths of the amount that fuel cost when steam was used for the same purpose. Furthermore, the motor-driven suction dredge was handling considerably more material. If the present price of coal was taken into consideration, the energy cost would be only about five-twelfths of the full expense.

(The friction losses in the motor would constitute a load, so that in practice the power factor could never reach zero.) The limitation to the exciting current prevents the motor from carrying its full kva. rating. Of course, variations of design will change the characteristics of motors, so the preceding statements are only general and must be modified under certain conditions. The extent to which a power user can afford to go in installing synchronous machines depends largely on the annual cost of power. The advantage to be gained may run anywhere from 10 per cent to 30 per cent of this amount.

Correcting Power Factor.—In the case of an isolated plant generating its own alternating current, the use of an over-excited synchronous motor at a leading power factor is often very desirable. Such a motor if properly designed may operate at a power factor, say, 80 per cent leading, while at the same time carrying three-quarters of its rated mechanical load in horsepower. Under this condition the motor may exert nearly the maximum corrective effect on the system's power factor. The magnitude of the system load and the power factor must be taken into consideration, however.

This problem of power-factor improvement cannot be met in the future, as it has been in the past, simply by the central station installing large synchronous condensers. It will become more and more desirable to have a connected load of many fair-sized synchronous motors scattered over the system. This is much better from the standpoint of voltage regulation, transmission efficiency, etc., than the old method of combining all the power-factor correction for the circuit in one or more synchronous condensers.

The result will be that central stations will encourage the use of synchronous motors more and more on their lines. This tendency is already apparent in many sections of the country, especially where large individual users of power are scattered over the system.

Changing Aspects of Factory Lighting Legislation

More Elaborate Classification of Requirements Desirable—Glare More Important than Intensity—Emergency Lighting Receives More Attention—Portable Photometer Facilitates Enforcing Legislation

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This article and one to appear subsequently have been written to review the marked changes which have taken place in state factory lighting legislation during the past months and to outline the principal revisions in the Factory Lighting Code of the Illuminating Engineering Society since June 1, 1917. Emphasis is placed upon the five main elements which call for legislation in this field and also upon the chief points which have come up for discussion in designing new codes and in revising the codes which have been in force since 1915. Notes are included on recent influences which have an important bearing on the intelligent enforcement of such regulations. Plans to give lectures on factory lighting to the state factory inspectors of Pennsylvania and New Jersey at the University of Pennsylvania are also outlined.

A REVIEW of the original I. E. S. Code of Lighting[1] for factories, mills and other working places seems especially desirable at this time for several reasons: (1) Because important revisions were made in it by the committee on lighting legislation of the Illuminating Engineering Society in June, 1917; (2) because a complete revision of the Wisconsin code has been under way since the fall of 1917; (3) because a lighting code committee was appointed in 1917 by the Ohio Industrial Commission to prepare a set of factory lighting regulations[2] for that State, and (4) because an important revision of the codes which were adopted in 1916 by the States of Pennsylvania and New Jersey was made in January, 1918.

To the four points cited there may be added the significant appointment by the committee on labor of the advisory commission, Council of National Defense, of a committee on lighting[3] for preparing a code of lighting for mills and workshops, having in mind four points, (a) the conservation of the eyesight of employees, (b) safety, (c) increased labor efficiency, and (d) larger output and decrease in spoilage.

From this list of very recent developments it will appear that the last half year has witnessed an unusual interest in the question of lighting rules for factory plants. Moreover, the two years which intervened between the preparation of the I. E. S. code in 1915 and the present have afforded additional experience and data on which to base the revisions of June, 1917. A number of interesting technical points have arisen in this work of revision, making the present an appropriate time for a brief discussion of these developments.

REVISIONS OF THE I. E. S. CODE

The original code of the Illuminating Engineering Society contained regulations on seven principal points as outlined in a preceding paragraph, these seven points being included in nine articles suggested as a basis for legislation or guidance. Following the issuance of this code in 1915, the States of Pennsylvania and New Jersey adopted it in slightly revised form, and it became effective in both States in 1916. After about two years these two States asked for revisions of the original code, if any were desirable, and requests for co-operation were received by the committee on lighting legislation from Wisconsin and Ohio, all of which convinced the I. E. S. committee that the time had arrived for a

[1] The original Code of Lighting for factories, mills and other workplaces, as discussed from various standpoints by the writer during the past two years (see ELECTRICAL WORLD, Vol. 66, No. 21, p. 1135, and Vol. 69, No. 25, p. 1203; *Factory* for September, 1917; *Industrial Management*, Vol. LV, No. 2, p. 117) contained regulations on the following principal points: (a) Intensity required for various classes of work, (b) distribution of light, (c) inspection and regular maintenance, (d) location of switches at entrances, (e) lighting of stairs and passages, (f) advantage of the overhead system of lighting, and (g) auxiliary or emergency lighting.

[2] A draft of this code is now available.

[3] ELECTRICAL WORLD, Jan. 5, 1918, on "Activities of the Engineering Societies in War Work."

careful study of its original code before further adoptions were made.

As a result the whole matter was carefully considered at a meeting in New York in June, 1917, and a decision reached to limit the suggested regulations to basic points, as follows: (1) Intensity requirements (which include the question of classifying industrial work), (2) the elimination of glare by proper shading

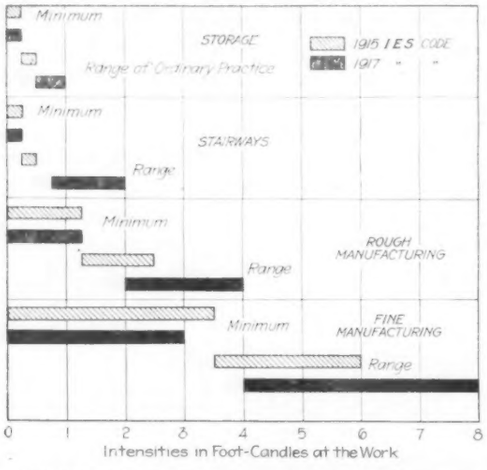

FIG. 1—COMPARISON OF THE INTENSITIES REQUIRED BY THE 1915 I. E. S. CODE OF FACTORY LIGHTING WITH THE REVISED INTENSITIES RECOMMENDED BY THE 1917 I. E. S. COMMITTEE ON LIGHTING LEGISLATION

of lamps, (3) the distribution of light on the work, (4) emergency lighting, and (5) pilot or night lamp control near entrances. A comparison of these revised rules with the original code can readily be made from the parallel passages in Table I, and also Tables II and III, which serve as a basis for the discussion to follow.

Distinction Between Value of Daylight and Artificial Light

Referring to Tables I, II and III, it will be seen that the revised rules omit all efforts to include daylight, except indirectly in the last two lines of Rule 1. This reference to natural light implies indirectly that the intensities of daylight which correspond with those for artificial light given in Rule 2 are satisfactory, namely, that there is no difference between the minimum requirements of artificial and of natural illumination. In the second paragraph of Article I of the original code the minimum requirements for natural lighting were set at three times those for artificial lighting. While experience indicates that some distinction between the two kinds of light, as outlined in the original code, is warranted, the committee did not feel able, in the present state of the art, to assign any definite figure for this difference, in spite of the fact that in 1915 such a distinction seemed advisable in definite form.

A comparison of Article V with Rule 2 shows that a slightly more elaborate classification of work seems desirable. Thus roadways and yard thoroughfares and office work are two new classes. Further, it was felt advisable to separate storage spaces and stairways, which were combined in the original code, making them into separate heads and increasing the range of intensities for ordinary practice for stairways. The committee also felt it desirable to insert a new classification between rough and fine manufacturing work to take into account those cases of rough manufacturing which involve a closer discrimination of detail than is implied by rough machinery or rough assembling. This new class is given under heading (e). Several minor, although important, changes are made in the intensity requirements.

Thus, for rough manufacturing the original code called for a minimum intensity of 1.25 and gave a range of 1.25 to 2.5 foot-candles for desirable practice. The revised rules do not change the minimum but increase the range from 1.25-2.5 to 2.0-4.0 foot-candles. The minimum intensity is given second place in the revised code so as to place extra weight upon the higher values of ordinary practice. Figs. 1 and 2 show these changes and values graphically, the former giving a comparison between the more important older values and the new revised values, while Fig. 2 shows the new values in complete form.

The note at the end of Rule 2 calls for measurements by a portable photometer. At the end of the last paragraph of Article V of the old code the use of such an instrument is recommended. The committee included a definite statement in the revised rules regarding the use of such an instrument with greatly increased confidence due to the commercial perfecting of the foot-candle meter (Figs. 3 and 4), which now places at the disposal of the state inspectors an inexpensive and sufficiently accurate instrument for checking up intensity values. Representatives of state labor boards have expressed the opinion that the appearance of such an instrument removes the chief difficulty in the enforcement of such legislation.

Glare More Important Than Intensity

Rule 3 of the revised code introduces into the body of the code the item of glare, which is looked upon as an item of even greater importance, in the present condition of industrial lighting, than the intensity require-

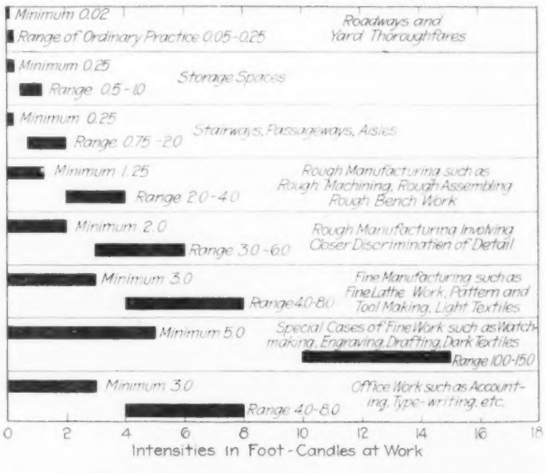
Minimum 0.02
Range of Ordinary Practice 0.05-0.25
Roadways and Yard Thoroughfares
Minimum 0.25
Range 0.5-1.0
Storage Spaces
Minimum 0.25
Range 0.75-2.0
Stairways, Passageways, Aisles
Minimum 1.25
Range 2.0-4.0
Rough Manufacturing such as Rough Machining, Rough Assembling Rough Bench Work
Minimum 2.0
Range 3.0-6.0
Rough Manufacturing Involving Closer Discrimination of Detail
Minimum 3.0
Range 4.0-8.0
Fine Manufacturing such as Fine Lathe Work, Pattern and Tool Making, Light Textiles
Minimum 5.0
Special Cases of Fine Work such as Watchmaking, Engraving, Drafting, Dark Textiles
Range 100-150
Minimum 3.0
Range 4.0-8.0
Office Work such as Accounting, Typewriting, etc.
0 2 4 6 8 10 12 14 16 18
Intensities in Foot-Candles at Work

FIG. 2—MINIMUM INTENSITIES AND RANGE RECOMMENDED FOR ALL CLASSES OF WORK LISTED IN THE REVISED I. E. S. CODE

ment. Considerable discussion has arisen during the past months as to the possibility of drafting a regulation covering glare which will be definitely enforceable. Obviously, such a rule, if readily interpreted, would be preferable to the general statement of Rule 3. It has been found difficult to formulate such a rule in definite terms, although there is reason to believe that a more tangible wording will develop in the near future. This

matter will be discussed in more detail later in connection with the recent revisions of the Wisconsin code.

Article VI and Rule 4 are comparable. Here again, as with Rule 3, there has been considerable agitation over a definite statement of what is meant quantitatively by "a good distribution"; in other words, what ratio of maximum to minimum intensity could be considered as falling within the meaning of a *good* distribution. This subject also will be referred to in greater detail under the Wisconsin revisions which are to be treated later.

There has perhaps been no rule which has received more careful attention than Rule 5, concerning emergency lighting. It has been felt that too drastic a ruling on an auxiliary system might work a hardship in some cases, whereas there can be little doubt as to the wisdom of such a provision for the great majority of industries. It is believed that Rule 5, in its revised form, covers the practical needs better than was the case with the old Article XI. The wording of Rule 5, however, leaves the interpretation of ways and means for the supply service for the emergency lamps to the judgment of the industrial commission or to its engineering representatives.

Old Article VIII contains a reference to control apparatus at the entrances of certain spaces. New Rule 6 makes such switching or controlling apparatus, at least for pilot or night lamps, essential for all main points of entrance.

SUMMARIZATION OF CHANGES WHICH HAVE BEEN MADE IN I. E. S. CODE

In summarizing the changes which have been made in the original I. E. S. code, a fair conclusion of the work of the committee on lighting legislation can be secured from the accompanying tables. Clauses or articles which were felt to be superfluous in the original draft have been omitted, and other important features have either been revised or added after the most careful and painstaking study by experts in this field. New and important additional weight will be given to these changes by the discussion in a subsequent article of the points which have come up through

TABLE I—PARALLEL PASSAGES FROM THE ORIGINAL AND THE REVISED I. E. S. CODE OF LIGHTING FOR FACTORIES, MILLS AND OTHER WORKPLACES

ORIGINAL CODE, 1915

ARTICLE III. All buildings, whether old or hereafter constructed, must be provided during those hours of work when natural light is insufficient or not available with adequate artificial light according to the following articles.

ARTICLE V. ARTIFICIAL LIGHT; INTENSITY REQUIRED.—The average illumination intensity throughout any month actually measurable in foot-candles on a horizontal plane through the work is to conform to the following table. Uncertain cases which arise as to how to classify given manufacturing operations are to be left to the judgment of a lighting expert.

Class of Work	Minimum Foot-Candle Intensity	Desirable Foot-Candle Intensity
Storage, passageways, stairways and the like	0.25	0.25– 0.5
Rough manufacturing and other operations	1.25	1.25– 2.5
Fine manufacturing and other operations	3.50	3.50– 6.0
Special cases of fine work	....	10.00–15.0

Where operations are performed on the sides of the work in hand, they shall be classified according to this table, and if the illumination is furnished from an overhead system, it shall preferably *be not less than 50 per cent* of the foregoing values, when measured on a vertical surface. If the illumination is furnished by an individual lamp or lamps close to the work, the intensity shall conform to the minimum or desirable intensities required in the foregoing table.

(NOTE.—As a guide to inspectors and others it may be stated that with modern lamps roughly 1 cp. per square foot produces an effective illumination of 3 foot-candles when the lamps are arranged according to the uniformly distributed overhead system, with mounting heights ranging from 12 ft. to 16 ft. above the floor, and when the light is directed from said lamps to the work in an efficient manner. A rough idea may thus be secured of the candle-power per square foot necessary to conform to the foregoing table of intensities by taking *one-third of the intensity values given in the foregoing table.*)

Thus for fine manufacturing and other operations the minimum foot-candle intensity is 3.5, which is approximately equal to 1.2 cp. per square foot. The use of a portable photometer or illuminometer, however, is recommended for the determination of existing systems, and all uncertain cases are finally to be established by these instruments.

ARTICLE VI. LAMPS AND MACHINERY, jointly, are to be so arranged as to avoid the casting of shadows over belts and other obstructions on important parts of the work, and the distribution of light from the lamps should be such as to avoid sharp contrasts of light and shade on the work.

ARTICLE XI. AUXILIARY LIGHTING should be provided in all large work spaces, such lamps to be in operation simultaneously with the regular lighting system, so as to be available in case the latter should become temporarily deranged.

AS REVISED, 1917

RULE 1. GENERAL REQUIREMENT:
Working or traversed spaces in buildings or grounds shall be supplied during the time of use with artificial light in accordance with the following rules, when natural light is less than the intensities specified in Rule 2.

RULE 2. INTENSITY REQUIRED:
The desirable illumination to be provided and the minimum to be maintained are given in the following table:

	Foot-Candles* at the Work	
	Ordinary Practice	Minimum
(a) Roadways and yard thoroughfares	0.05– 0.25	0.02
(b) Storage spaces	0.50– 1.00	0.25
(c) Stairways, passageways, aisles	0.75– 2.00	0.25
(d) Rough manufacturing such as rough machining, rough assembling, rough bench work	2.00– 4.00	1.25
(e) Rough manufacturing involving closer discrimination of detail	3.00– 6.00	2.00
(f) Fine manufacturing such as fine lathe work, pattern and tool making, light-colored textiles	4.00– 8.00	3.00
(g) Special cases of fine work, such as watchmaking, engraving, drafting, dark-colored textiles	10.00–15.00	5.00
(h) Office work such as accounting, typewriting, etc.	4.00– 8.00	3.00

*The foot-candle, the common unit of illumination, is the lighting effect produced upon an object by a standard candle at a distance of one foot; at two feet the effect would be not one-half foot-candle, but one-fourth foot-candle, etc. A lamp which would give off 16 cp. uniformly in all directions would produce a uniform illumination of one foot-candle at a distance of four feet in any direction.

NOTE.—Measurements of illumination are to be made at the work with a properly standardized portable photometer.

RULE 4. DISTRIBUTION OF LIGHT ON THE WORK:
Lamps shall be so installed in regard to height, spacing, reflectors or other accessories as to secure a good distribution of light on the work, avoiding objectionable shadows and sharp contrasts of intensity.

RULE 5. EMERGENCY LIGHTING:
Emergency lamps shall be provided in all work-space aisles, stairways, passageways and exits to provide for reliable operation when, through accident or other cause, the regular lighting is extinguished. Such lamps shall be in operation concurrently with the regular lighting and independent thereof.

FIG. 3—THE FOOT-CANDLE METER, WHICH PROMISES TO BE OF MUCH HELP IN THE CONTROL OF INDUSTRIAL LIGHTING

the work of committees or engineers in various states where attention has been directed to lighting legislation during the past six or eight months.

FIG. 4—READINGS OF ILLUMINATION MAY BE MADE VERY SIMPLY WITH FOOT-CANDLE METER

Two fundamental requirements must be met if state regulations of this kind are to be enforced intelligently. The one is to place at the disposal of the state factory inspectors instruments suitable for measuring illumination intensity, and the other is to train the inspectors themselves in the fundamentals of illumination so that they may be capable of sizing up a lighting installation for its main defects at a glance, and at the same time may appreciate the economic advantages of good factory lighting to such an extent that the enforcement of such rules will appeal to them and that they, in turn, may convincingly represent to the factory owner that the adherence to such rules is in no sense a hardship but a benefit to his employees and consequently to his plant as a whole. One channel through which education of this kind is planned for the definite help of the inspectors in two states, along with details of the new and forthcoming state codes which have grown out of the revisions of the I. E. S. code discussed in this article, will be outlined in the subsequent paper on the same general topic.

TABLE II—ARTICLES OF 1915 I. E. S. CODE WHICH WERE OMITTED OR RADICALLY REVISED IN 1917 CODE

ARTICLE I. DAYLIGHT.—All buildings hereafter constructed must be provided with adequate window area. Awnings, window shades, diffusive or refractive glasses must be used for the purpose of improving daylight conditions or for the avoidance of excessive brilliancy wherever they are essential to these ends.

The windows, skylights, saw-tooth or other roof lighting constructions are to be arranged with reasonably uniform bays, and the daylight openings shall be so designed and proportioned that at the darkest part of any work space, when normal exterior daylight conditions obtain, there shall be available at least a minimum intensity equal to three times the minimum intensities given in Article V for artificial light.

NOTE.—The intensity requirements for daylight are higher than those for artificial light because the physical condition of the eye during the daytime is usually such as to require a higher intensity of natural light for satisfactory vision than is required at night under ordinary well-designed artificial lighting systems.

ARTICLE II. Old buildings at present constructed and not having adequate window area must be provided with adequate artificial light according to the following articles, so as to supplement the natural light during normal daylight hours.

ARTICLE IV. Adequate intensity of the light must be provided for each class of work, both on a horizontal plane as well as on a vertical plane passing through the work, according to Article V. In all cases, however, glare on working surfaces is to be avoided as it tends to reduce the visual efficiency of the workmen and to increase the likelihood of accidents.

ARTICLE VII. INSPECTION AND REGULAR MAINTENANCE of all lighting systems is required in spaces where work is being conducted, and in no case must the lighting devices, whether windows, lamps or auxiliaries such as globes and reflectors, be allowed to deteriorate, due either to dirt accumulations or to burned-out lamps, more than 20 per cent below the minimum intensity values required by Article V.

ARTICLE VIII. ROADWAYS, YARDS AND PLACES NOT USUALLY FREQUENTED must either be provided with illumination during working hours when natural light is absent or partly absent, to make them safe against accident to employees traversing or engaged in such places, or a convenient control or controls must be placed at the entrance to basements, stock rooms and the like, so that a person on entering can readily turn on the lamps beforehand.

ARTICLE IX. STAIRWAYS AND PASSAGEWAYS must be provided with lamps and reflectors or shades carefully located so as to shed their light generally over the entire space or spaces involved, and in sufficient quantity to make the stairways and passages safe against accident to employees traversing or engaged in such places. For intensities see Article V.

ARTICLE X. Each working space is preferably to be illuminated by lamps mounted overhead according to the system of general lighting, in preference to individual lighting. The overhead method of lighting, besides possessing many other advantages, also tends to reduce dark spots throughout the floor area, a feature usually objectionable with the use of individual lamps. This particular article is not an absolute requirement, but a suggestion enforceable at the discretion of a lighting expert.

TABLE III—NEW RULES WHICH WERE INSERTED IN 1917 REVISION OF I. E. S. CODE THAT HAVE NO PARALLELS IN 1915 CODE

RULE 3. SHADING OF LAMPS:
Lamps shall be suitably shaded to minimize glare.
NOTE.—Glare, either from lamps or from unduly bright reflecting surfaces, produces eye-strain and increases accident hazard.

RULE 6. SWITCHING AND CONTROLLING APPARATUS:
Switching or controlling apparatus shall be so placed that at least pilot or night lights may be turned on at the main points of entrance.

Fan, Blower and Air-Compressor Applications

With reference to his contribution on "Fan, Blower and Air-Compressor Applications," which appeared in the ELECTRICAL WORLD for Jan. 26, Prof. C. E. Clewell writes:

"My attention has been directed to a possible misinterpretation which may be made of the statement on page 197 reading: 'With an alternating-current supply all types may be driven by induction motors.' C. M. Lynge of the Pittsfield Works, General Electric Company, has indicated to me that, while this statement is literally true, it might have been elaborated to include both single-phase and three-phase supply.

"Mr. Lynge is engaged in the design of alternating-current motors for propeller fans, and he mentions the development by the General Electric Company of a straight repulsion-type motor known as the type R motor for operating propeller fans, and also the fact that exhaust fans are operated most satisfactorily by motors possessing series characteristics in order to give positive starting and to compensate for load changes due to restricted inlets or outlets, to opposing winds and the like. On this account the straight repulsion motor, as pointed out by Mr. Lynge, is desirable. A motor possessing series characteristics may, in fact, readily be used since the direct-current propeller fan is always under load irrespective of outlet restrictions and cannot therefore reach excessive no-load speeds.

"Mr. Lynge also points out the fact that when an induction motor operates a fan in a duct system against a restricted outlet the motor will be heavily overloaded because of the corresponding drop in speed, and that the repulsion motor is therefore preferable to the induction type for fan service. These comments by Mr. Lynge are submitted for the purpose of avoiding any misunderstanding of the statement referred to above."

Logic of Public Utility Consolidations

Both Physical and Fiscal Combinations Are Economical of Investment and Operating Cost and a Public Benefit—Statistics of Progress —Centralized Power Production

BY CLARENCE P. FOWLER

IT IS generally conceded that public service enterprises are natural monopolies and that the best interests of the public are served when such undertakings are operated as monopolistic but regulated enterprises. When such monopolies are properly regulated and at the same time protected from the unjust attacks of the ever-present demagogue the necessity for competition vanishes. Competition as a means of checking certain corporate abuses has proved itself damaging to the investor in public service securities and it has also been demonstrated that a competitive situation in the operation of utilities is a menace to public welfare.

The inherent monopolistic nature of the public service business is accorded the fullest recognition in those states where commission supervision of public service corporations is most firmly established, notably in New York, New Jersey, Massachusetts and Wisconsin. The position taken by the Massachusetts and Wisconsin commissions is reflected in recent decisions pointing out the failure of competition as a regulator of public utility service and rates.

Competition and Regulation Are Contradictory

The suppression of competition in furnishing public services has been the outgrowth of bitter experience. In fact, competition and commission regulation are contradictory, and the latter to be effective should be of such a nature that the profits from any one enterprise should not be sufficiently large to warrant wasteful duplication of capitalization through competition for the same business. Particularly is this true when, as is most frequently the case, such competition affords no additional facilities or service and is neither an extension or improvement over existing service.

The unified method of handling public service enterprises is co-operation whereby waste, duplication and the depleting warfare of competition can be avoided. It may also be termed the labor-saving, capital-conserving and modernizing appliance of the public service business.

The tendency to unite groups of public service properties, whether contiguous or not, suggests that consolidations may be divided broadly into two radically distinct classes—physical and fiscal.

The actual union of service in contiguous properties generally involves a certain amount of physical reorganization, bringing the system into unified action and securing the full advantage of single equipment and management. Practically without exception, the public gains by every consolidation of this character.

The American steam railroad corporation may be said to be the pioneer in the movement toward physical consolidation in the public service business on this continent. As an illustration of the adverse circumstances which confronted the shipper or traveler on the early American railroad the conditions at one time existing between New York and Chicago are typical. One part of this route, between Albany and Buffalo, a distance of only 297 miles, was originally served by no less than eleven individual railroads, owned by as many distinct companies.

Then, again, to those engaged in commerce and transportation it became evident that, with the growth in population, the exchange of commodities between districts of production and consumption would be seriously hampered by unrestrained competition between rival lines, the effect of which is to favor certain towns and cities known as competitive points which are served by two or more railroads. At competitive points, without consolidation of the properties interested, freight rates are usually fixed at little above the cost of transportation, making it necessary for the non-competitive points served by only one line to provide the major portion of the funds required for operating charges, interest and dividends. As a result of this state of affairs population and industry become congested at localities where rail and water competition reduces the cost of transportation, thus rendering it extremely difficult for many industries to succeed in locations which are served by no more than one line of railroad. If, however, a consolidation of railroads, serving a certain territory, is effected, it is conceivable that with such a readjustment of rates between competitive and non-competitive points each will contribute its proper share to the operating expenses and fixed charges of the various constituent companies.

Great Railroads Completely Unified

The most recent and impressive example of the consolidation of public service corporations and the fullest recognition of its advantages is found in the decision of our federal government to unify the operation of all of our great transportation arteries into one gigantic railroad system. This contemplates the pooling of all traffic and facilities, the common use of terminals, tracks and equipment, and the hauling of freight by the shortest route regardless of billing.

While this is not a time for captious criticism, however, it is worthy of note that the government has for a generation denounced pooling and has, through the Interstate Commerce Commission, succeeded in repressing it. The adoption of pooling now justifies the assumption that its suppression in the past may be regarded as an error, for the reason that if this method of operation offers the nation a more effective conduct of the industries incidental to the war, it seems reasonable to affirm that it would in the last thirty years have increased the effectiveness of the industries of peace.

Fiscal consolidations, of which the holding company is an example, possess the advantage of bringing a group of properties under a single and intelligent management with strong financial backing and render it possible to make economies and give better service which benefits the public. The holding company greatly

increases the development and service efficiency, as the different departments of operating companies included in a holding company are constantly under the stimulus of competition with similar departments in other companies of the group.

Holding companies make possible the procurement of capital for the development of public utilities which would otherwise not be developed at all or at best would be incompletely or inefficiently expanded. In rare instances are communities able to supply adequate funds for the creation and development of public services of the most approved type. The necessary capital must be secured from without, and this is especially advantageous for sections not fully developed, which are thus enabled to draw upon older and richer portions of the country. The capitalist, as a rule, is not willing to scatter investments in small isolated units throughout the country because it is practically impossible to give each one the proper attention. He prefers rather to invest in the holding company, relieving himself of the burden of supervision while, at the same time, securing a desirable diversification of risk. Moreover, the financial strength and prestige of the holding company is able to command capital and purchase materials and supplies on more favorable terms than the small individual company, and this means better rates.

It is of interest to show the tendency toward the holding company idea in the electric central-station industry as reflected by recent statistics compiled from authentic sources. These figures were gathered primarily to show the number of central stations owned or controlled by syndicate interests, the number owned independently and finally the number of municipally owned plants. These investigations were confined to towns and cities of 1000 population and more and are subdivided separately for communities of from 1000 to 5000 population, from 5000 to 10,000 population, 10,000 to 50,000 population and of more than 100,000 population. The totals for the entire country, eliminating, of course, communities under 1000 population, show that out of 4774 electric lighting plants 29 per cent have syndicate affiliations, 48 per cent are independent and 23 per cent are municipally owned.

It appears that the largest proportion of syndicate plants is in the Eastern States, with the next largest in the New England States, the Western States being third, Middle States fourth and Southern States last. The percentage of municipal plants is largest in the Middle States, with the South next and West third.

Proportion of Syndicate Plants Grows

The proportion of syndicate plants becomes larger as the size of the communities increases. Thus the proportion of syndicate plants advances from 20 per cent of the total number of plants for the smallest towns to 87 per cent in cities of the largest size. Conversely, the proportion of independent plants decreases as the size of the community increases; where it was 55 per cent of the total in towns of 1000 to 5000 inhabitants, it decreased to 10 per cent in cities of the largest size. The proportion of municipal properties also decreases as the size of the community increases. Where municipal plants formed as much as 25 per cent of the total for towns of 1000 to 5000 population, the proportion decreased to 3 per cent for the largest cities.

Of approximately $5,000,000,000 securities invested in street railways, about 82 per cent are organized into or affiliated with holding companies. Of about $3,000,000,000 securities outstanding in the electric light and power business, about 83 per cent are operating subsidiaries of holding companies. Of the $1,500,000,000 outstanding securities of gas companies, in excess of 66 per cent are organized into or affiliated with holding companies. Thus out of approximately $9,500,000,000 traction, electric light and gas capital about 80 per cent is now organized into or affiliated with holding companies.

Advantage of Central Electrical Plants

Centralized electric power production, with a single high-tension transmission network serving a large area, forms a typical example of public utility consolidation, which is justly claiming additional attention.

Interesting figures concerning an electric lighting and power system serving one of our largest metropolitan centers may be cited. The average yearly load factor (or the ratio of the average to the maximum load) was only about 30 per cent. Further, 97 per cent of the total kilowatt-hour output was produced by 50 per cent of the generating capacity, while it was necessary to have an investment in the remaining 50 per cent of the generating capacity to handle peak loads; but this latter half of the generating capacity generated but 3 per cent of the output. In other words, it may be stated that 50 per cent of the generating equipment was operated at about 46 per cent load factor, whereas the balance of the generating apparatus was operated at only about 5 per cent load factor. This example of the rather poor earning capacity of a large portion of the investment points to the urgent necessity for the creation and development of unified power systems.

That consolidated systems of power supply have not reached their fullest development is illustrated by the writer's recent experiences in the investigation of already extensive properties of this type, which contemplate further transmission line connection with similar systems serving contiguous territory but controlled by outside financial interests.

Modern hydroelectric systems operate to prevent the monopolistic use of water powers, so common in past years, and make possible the subdivision and distribution of these powers in the smallest units, thereby rendering the greatest good to the greatest number. In fact, not only do these hydroelectric enterprises make possible the supply of water power to a great many small consumers that could not be supplied without them, but through the medium of long-distance electrical transmission several powers on the same stream, or even different streams, may be linked together physically, and with the power of several watercourses so connected under common control a great diversity in power demand and supply is secured. Diversity in power supply often means that it is practicable to match the minimum discharge on one stream with a higher on another or to interchange power of streams having large storage capacity with those having little or none, which increases reliability of power supply and in many cases avoids the use of expensive auxiliary steam power, resulting in advantage to the public in keeping down rates and with common control giving the consumer at one point the advantage of securing water power from another point, perhaps 200 miles (321.8 km.) away.

Increasing Carrying Capacity of Underground Cable

The Substitution of Crude Vaseline for Air in Ducts Will Reduce Heating Effect, Eliminate Hot Spots, Decrease Electrolysis and Afford Mechanical Protection

BY E. O. SCHWEITZER
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REALIZING that the dissipation of heat from cables is limited by the high heat resistance of the cables and surrounding medium, the writer has conducted a laboratory investigation in which the space between a section of cable and the inclosing duct was filled with crude vaseline. As a result of the test it was concluded that such practice increases the carrying capacity considerably, eliminates hot spots, decreases electrolysis and affords mechanical protection. Before the practical value of such an arrangement can be determined, however, it will be necessary to conduct investigations in connection with actual installations.

The tests were made on a 45-ft. (13.7-m.) length of 250,000-circ. mil., 12,000-volt, three-conductor cable, 15 ft. (4.6 m.) being run through stone conduit. Measurements of the copper and sheath temperatures were made at different points within the conduit by means of thermocouples. The joints and ends of the conduit were sealed with concrete, a pipe being introduced at either end for filling purposes. The three conductors were connected in series and current was circulated through them at low pressure. No pressure was applied between conductors and sheath during the various heat runs. A general view of the set up is shown in Fig. 1.

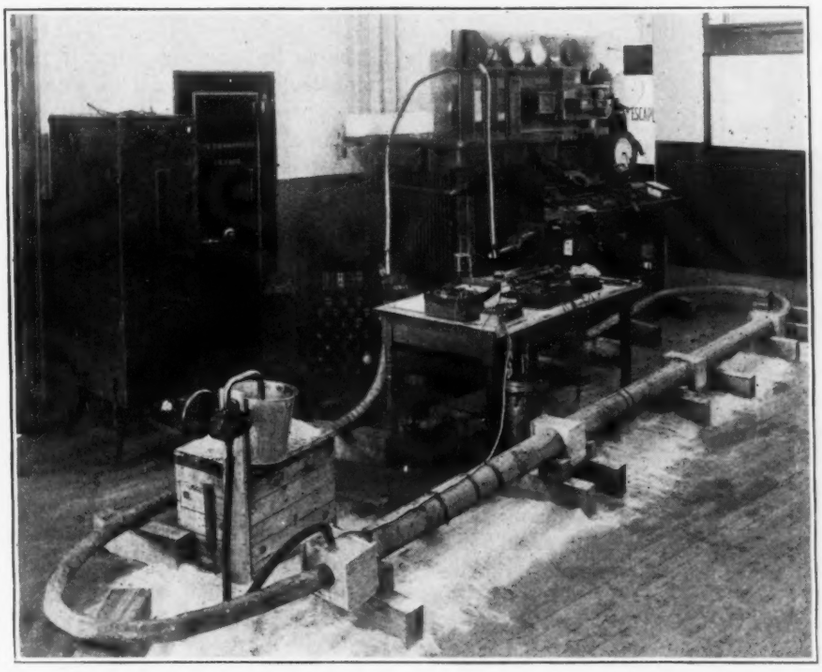


FIG. 1—VIEW OF LABORATORY IN WHICH CARRYING CAPACITY OF CABLE WAS TESTED

COOLING MEDIUM EMPLOYED

Crude vaseline, commonly known by the company's employees as "cable grease" and called "dark petroleum" by the manufacturers, was used in this test, as it was found to be inexpensive and to possess good characteristics as a filler for the space between the duct and cable. It has a very high viscosity and does not become fluid at any safe operating temperature for cable. These properties tend to prevent its escape through concrete or tile ducts and may be considered real advantages should the ducts prove pervious to highly fluid materials. However, it is generally held that concrete is quite impervious, as the latest engineering experience and data indicate that it is being successfully used in tanks for the storage of oil. The filling of the ducts presents no serious difficulty as the grease can be heated until fluid and readily pumped in.

Other methods for the removal of heat from cable in duct lines have been tried, but all of them appear much inferior to the crude-vaseline plan. The use of air blowers by the Duquesne Light Company, Pittsburgh, Pa., for cooling an overheated duct line lowered the temperature of the cable by about 12 per cent. The high-capacity blowers necessary in alternate manholes make the cost of such a cooling method prohibitive and applicable only in isolated cases. Dissipation of heat by circulating water, tried by other companies, is also inferior on account of the danger from cable failures due to defective sheaths, electrolysis and corrosion.

Some preliminary experiments on improving the heat-dissipating quality of the crude vaseline by introducing other materials, such as graphite, seem to show that the additional cost will offset any advantage. This phase of the subject will probably be investigated further, however. At the same time the favorable effect of introducing flake graphite in the cement itself will be determined. The possibilities of both these lines of development are strictly limited, however, by the characteristics of the cable now in use.

The "internal" heat resistance of the conductor and belt insulations of cables now in service is a fixed and unalterable quantity. On the other hand, the "external" heat resistance from the cable sheath to the earth surrounding the ducts is a variable and can be decreased considerably by replacing the air now present by materials having better heat conductivity, such as crude vaseline. The resulting improvement in heat dissipa-

tion from conductor to earth, however, will depend on the relation of the "internal" to the "external" heat resistance. This relation for any fixed cable installation is a definite ratio which increases with any reduction in the "external" heat resistance. The degree of effectiveness of any cooling means is thus limited, depending upon the value of this temperature gradient in the cable itself.

For cables now in service test results showed this "internal" heat resistance to be about 60 per cent of the total, with air in the ducts. Hence, if it were possible to introduce a perfect conductor between sheath and earth, the current-carrying capacity could be increased only 29 per cent. But if the "internal" resistance were 50 per cent under such ideal conditions, the current-carrying capacity could be increased by 42 per cent. Therefore it is evident that the greatest obstruction to rapid dissipation of heat from cables now in use is in the cables themselves.

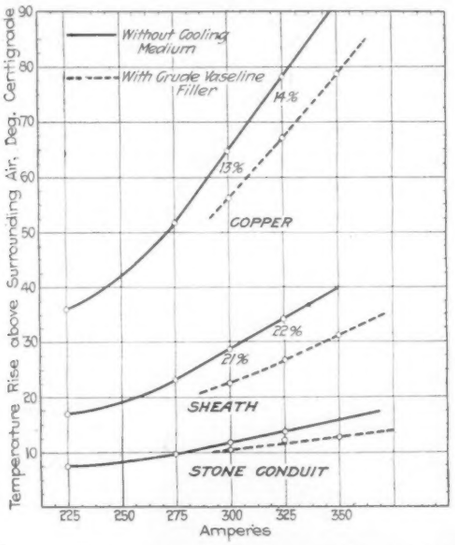


FIG. 2—EFFECT OF CRUDE VASELINE FILLER ON CARRYING CAPACITY OF CABLE

This fact emphasizes the desirability of using in all future installations cable in which the "internal" heat resistance is as low as possible. In this connection recent investigation has shown a marked difference in the heat conduction of paper-insulated cables, depending upon the kind of impregnating compound used. The use of vaseline to "short-circuit" the heat resistance of the air ducts, however, has been found to result in notable improvement.

Advantages of Using Filler Between Cable and Duct

Increased Capacity.—With crude vaseline in the conduit, the copper temperature is reduced 14 per cent at a load of 325 amp., as shown by accompanying heating curves. This reduction in temperature will, of course, permit carrying 7 per cent more load for the same rise. The degree of effectiveness of the vaseline seems to increase at higher temperatures, as shown by slope of the curve. This, together with the elimination of "hot spots," as noted below, will allow a much higher operating temperature for the cable and a corresponding larger increase in capacity.

Elimination of "Hot Spots."—In addition to the more rapid dissipation of heat, a more even temperature was obtained in the cable itself. A difference of copper temperature of 3½ per cent on the same conductor at points 5 ft. (1.5 m.) apart existed without the filler in the ducts; with it this difference was reduced to 0.5 per cent. As the fundamental cause of many cable failures is overheating at certain "hot spots," such an equalizing of temperature is important. In connection with the present practice of some electric service companies of reinstalling old cable in which weak points are very likely to exist any additional factor of safety seems well worth obtaining.

Decreased Electrolysis.—It is believed that the use of the vaseline as an insulating medium surrounding the cable sheath will eliminate trouble due to electrolysis. Tests have been projected to prove this point.

Mechanical Protection.—The value of the vaseline as a means for preventing the mechanical abrasion of the lead sheath is apparent. Where such faults already exist the grease will be effective in preventing failures.

Expense Involved

Introduction of crude vaseline between the cables and ducts would be attended by considerable saving in many cases in Chicago not only in old duct lines but also in new construction. However, it would not be advisable to consider using it in the entire system of transmission. It would be especially beneficial on circuits which feed the loop district and are operated at maximum load nearly all day, or on certain tie lines that are very heavily loaded.

To replace the air space in stone conduit with grease when occupied with 250,000-circ. mil., 12,000-volt cable will require about 1.5 lb. per ft. (2.23 kg. per m.) of duct length. At 4 cents per pound (8.9 cents per kg.), allowing 2 cents per foot (6.6 cents per m.) for labor, the total cost of introducing filler will be in the neighborhood of 8 cents per single-duct-foot (26.2 cents per single-duct-meter). Assuming an actual circuit having a length of 50,000 ft. (15,240 m.), the investment represented, at $1.80 per ft. ($5.90 per m.) for the 250,000-circ. mil. cable, 25 cents per single-duct-foot (82 cents per single-duct-meter) for conduit, and $3,000 for operating apparatus at generating and substation ends, is $111,000. To obtain 7 per cent increased capacity with new equipment would cost $7,770, whereas obtaining it by using vaseline filler would cost only about $4,000, an approximate net saving of $3,770. On the basis of increasing the capacity of fourteen lines by 7 per cent a net saving of one line could be realized, where such a large group of parallel lines is required.

Magnets Recover Sunken Pig Iron

The Arrow Transportation Company, operating barges on several Southern rivers, lost one barge in the Tennessee River near Paducah last March. This barge, loaded with 420 tons of sand-cast pig iron, collided with the pier and dropped its load gradually. The loss represented about $10,000, and the insurance company paid this to the transportation company. The insurance company arranged to recover what it could by means of a lifting magnet purchased from the Cutler-Hammer Manufacturing Company, Milwaukee, and approximately 400 tons were recovered. Because of the rising cost of pig iron it was sold for $16,000. Total cost of recovering amounted to $4,000.

Raising Wages with Cost of Living—II

A Plan for Paying Workers in the Electrical Contracting Industry on the Basis of Living Cost as That Cost Is Indicated by Index Numbers of Responsible Commercial Organizations

BY L. K. COMSTOCK

This is the second and final article on the views of Mr. Comstock on this vital topic, first presented before the Conference Club and published here because of the critical character of the relations between capital and labor.

FOR years it has been a common practice to trace general commodity price tendencies and reduce them to a common number called an index number. This index number is indicative of general tendencies and takes due account of both the simultaneous rise and fall of different commodity prices and their proper weighting. There are several institutions producing these index numbers monthly, and they are in general agreement, although developed in different ways.

A cursory examination shows that seven series of index numbers, made by five independent organizations, have a marked family resemblance. The testimony concerning the major facts of price fluctuations from these seven different sources is so unanimous that one can scarcely doubt its validity.

PRICES LIKELY TO CONTINUE TO RISE

In thinking of index numbers it should be remembered that during the last twenty years throughout the gold standard world the general level of prices has been rising, or, in other words, the purchasing power of gold has been falling; that all indications point to the continuation of this tendency for many years to come, and that this progressive shrinkage in the purchasing power of gold is a serious menace to the stability of business, disturbing the normal relations between those forms of income or prices which are relatively fixed, such as interest, rent, salaries and wages, and those which are more promptly adjusted, such as the prices of most staple commodities.

It is entirely within the possibilities that prices may rise more and more slowly until many years hence we shall see the culmination of this rising price epoch unless in the meantime wonderful new gold fields are discovered. The synthetic chemist and the electrical engineer may, of course, check this rising tide of prices in spite of any failure to discover new gold deposits sufficiently large to be effective. The generation which succeeds in producing flour and meal and sugar cheaply, by a synthetic process, will have made vastly more progress in world production than the nineteenth century made when it added the Mississippi Valley and the Canadian and South American plains to the world's producing areas.

Rising prices are by no means an unmixed evil; for a prolonged period of rising commodity prices energizes the business world generally, operates to the advantage of debtors and of owners of production processes, and to the disadvantage of creditors generally, of wage earners, of salaried persons and of receivers of fixed incomes; causes interest rates to rise, lessens the severity of crises and the duration of depressions, and stimulates social reconstruction.

During the decade 1899 to 1909 the general price index rose from 99.5 to 130, an increase of over 30 per cent. In other words, the commodity price level went up faster than the money earnings of labor, according to the figures prepared by the Bureau of Labor Statistics; and hence the real annual returns of labor showed a decline, slight in some trades but large in others. The evidence, then, indicates that all the intrenchments of organized labor, all the legislation in favor of the laboring classes, have failed to prevent the downward trend of commodity wages.

To consider specifically the application of such an index number to the wage scale of the New York Electrical Workers' Union, let us assume a base or par rate of wages, arrived at by mutual agreement, say, for instance, $5.20, which is the rate that went into effect April 1, 1917. Dun's index number on that date was $190.012. Let us assume that wages shall be readjusted once in six months. Dun's index number of Oct. 1, 1917, six months later, was $219.679, or an increase in general commodity prices of $29.667, or 15.6 per cent.

On the authority of the Bureau of Labor Statistics, the wage earner spends three-quarters of his wages for food, clothing and rent and other things responding to these general price fluctuations; he would, then, set aside $3.90 out of the $5.20 for subsistence. The index number for the end of the six months' period indicates that subsistence costs 15.6 per cent more; therefore increase $3.90 by 15.6 per cent, making it $4.50, to which should be added the quarter of the base rate not affected by the commodity market, $1.30, thus making the readjusted rate $5.80, or a net advance over the base rate of 60 cents per day.

The corresponding Bradstreet numbers are 14.5769 and 16.9117; the difference, 2.3348, shows an increase in the index of almost exactly 16 per cent. Applying this number as before, the adjusted wage is $5.824, or an advance of sixty-two and four-tenths for the six months' period ending Oct. 1, 1917.

Let us examine the rate of wages of the New York Electrical Workers' Union from the index number point of view over a longer period of time, beginning with the year 1900. The rate in 1900 was $3.50 per day. The Bradstreet index for that year was 7.88. The average monthly index for eleven months of 1917 was 15.4595. The difference between the two indexes, 7.5995, shows an increase in 1917 of 96 per cent. Increasing three-quarters of the 1900 rate by 96 per cent ($2.52), the corrected rate for 1917 would be $6.015, or, in other words, the purchasing power of a wage of $3.50 in 1900 is just equal to the purchasing power of a wage of $6 in 1917.

RELATION OF WAGE INCREASES TO CONTRACTS

It may be argued that a periodic adjustment every six months would interfere with contracts in course of execution. Let us admit this objection and at the same

time analyze it. If no allowance were made in estimating future work for the contingency of an unknown advance in the rate of wages due to the change in the index number, then under the conditions specified above the advance of 60 cents would cost the contractor 3.9 per cent, assuming the labor to be 35 per cent of any given contract, or 2.78 per cent, assuming the labor to be 25 per cent of any given contract.

Increased Labor Efficiency a Factor

An advance in the rate of wages which apparently increases the cost to the employer 3.9 per cent would be, in my judgment, more than offset by an increased labor efficiency; because the employee would be appreciative of the spirit of co-operation reflected by the adoption and practice of a plan of wage adjustment calculated to protect him against advances in the cost of living, and he would, consciously or unconsciously, respond to such an effort at practical co-operation on the part of his employer.

It should be stated, however, that in the example cited above the index number used might not be quite accurate in this particular application, because it is composed to some extent of factors which affect the cost of living only vaguely and indirectly. This number, for instance, gives the aggregate prices per pound of ninety-six different articles, including not only all kinds of food products, but also thirteen metals, eleven chemicals and drugs, seven building materials, and also raw and manufactured textiles, coal and coke, mineral and vegetable oils, naval stores, and seven miscellaneous articles; but nevertheless it gives a broad general indication of the changes in general price levels, and so perhaps would be as applicable as an index number derived from the price movements of only foods, clothing, rent and fuels.

It may also be argued that this plan of wage readjustment would tend continually to raise wages even beyond the critical point at which the tendency would begin to slow down the industry. This objection leads to a consideration of the fundamental theory of wages.

Labor has a value because its services or products have a value. If the labor is misspent, the product is valueless, and in the long run the labor will be equally so. Labor secures a remuneration because it produces something for which people are willing to pay. In other words, wages depend on productivity. The wages of the laborer depend upon the value of his labor and not upon his wants. But wages vary with the standard of life, and anything which lifts the standard will raise the rate of wages. The highest standard, though, will not prevent wages from falling in the face of a decrease in the demand for the product and a decline in industrial prosperity. However, anything which tends to increase the productivity of labor will raise the rate of wages. Raising the rate of wages in the long run will raise the standard of living, and in general a higher standard of living reflexively raises the productivity.

This being so, we can safely leave this objection as being one which might as well apply to the present method or any other method of readjusting wages.

It will be argued that union men will not be content with a relatively constant wage position in the economic world; that they will demand also an absolute advance, an advance beyond the point indicated by an index number. As long as the national wealth tends to increase faster than the population, this demand on the part of union labor will be justified and will be justified in some more or less definite ratio to the increase of national wealth. This is the laboring man's only way of participating in an increased national wealth, national surplus, in the creation of which he has had so large a share. The demand for an absolute increase on the part of any particular trade, however, will be restrained by force of public opinion and by economic forces if such a demand is out of step with the demands of other trades requiring equal or similar skill.

Some may say that the advance in wages in the electrical trade has been absolute instead of relative, and they may point to the wages of the Chicago union as an example. Let us analyze this case from the index number point of view. In 1907 the wages in Chicago in the electrical trade stood at $4 per day. The Bradstreet index number for 1907 averaged $8.90. On Sept. 1, 1917, the index was 16.6441, and the average index number for twelve months of 1917 was 15.655.

Applying as before the average index number for 1917 to this case, we find that a $4 wage in 1907 would be equivalent to $6.28 in 1917. If, however, we compare the average index number for 1907 with the index number for Sept. 1, 1917, when the $6.25 wage took effect in Chicago, we get a wage of $6.61, which shows how conclusively the $6.25 wage is justified and also that there has been no absolute advance whatever.

By the intelligent application of some such plan as the one outlined, there will result as a matter of fact an absolute advance in wages to the union man, due to the fact that he will work more days in the year when and because wage disputes are eliminated. This absolute advance is not one in the economic sense, but purely in the personal sense.

After all, any discussion of the wage question, if confined to the rate of wages per day, is inadequate and superficial; the yearly income is the only important desideratum for a wage earner, as it is also for any person whose income takes any other form.

Fixing the Base Rate of Wages

There remains the more difficult problem of scientifically fixing the base rate for wages. This is a much more complex problem than applying an index number to raise or lower the base. It would probably be sufficiently correct to assume any present wage as a base rate; it would certainly avoid endless discussions and fruitless speculations on the cost of keeping an average family. Probably all parties concerned would rather avoid the question by arbitrarily accepting the existing rate than to create a new rate, however scientific.

The United States Bureau of Labor has selected the years 1900-1909 for striking an average to serve as a base, or par, for developing its index number. Commodity prices for this period are averaged for the ten years and the result is called 100. If the weighted average of basic commodity prices is 3 per cent higher for 1913, the index number for 1913 is + 3 or 103. A base or par rate of wages could similarly be established from the prevailing wages during the same ten-year period and in as many localities as might be found desirable. Wages could then be adjusted from this par periodically by comparing the index number corresponding to par with the index of the next period preceding the time selected for adjustment.

Liberty Loan Sale Stimulants

The Use of the Spirit of Competition Within the Company to Produce 100 per Cent Participation—Bulletin Boards, Thermometer Charts and Other Methods for Keeping Up the Interest of Employees

IN TWO weeks the national campaign on the third Liberty loan will open, to continue for three weeks. As was pointed out last week, the success of this loan lies not wholly in the total subscription but to a considerable extent in the number of people participating.

To a large extent, therefore, the employers of labor are in a position to make this the most successful of the three loans. Employees must be made enthusiastic

FIG. 1—A TYPICAL GRAPHIC CHART SHOWING PERCENTAGE OF EMPLOYEES SUBSCRIBING

—made to understand why they should lend their money to the government. Plans, therefore, must be laid to insure a 100 per cent subscription in every plant, shop and office in the electrical industry.

An investigation is being made by the ELECTRICAL WORLD of how other employers have interested their help in the preceding loans in order to give to the industry the best results of the experience of others.

Last week the necessity of getting together a committee of the men was emphasized. This week another preliminary step is to be developed—making a plan to stimulate interest throughout the campaign.

Because of the human element in every man, the competition method of sustaining interest is the most common one and the one which is most uniformly successful. Under this method departments can be played against each other or any other division of employees that naturally suggests itself very effectively. Where there are a number of district offices this plan can be followed out between offices.

In using this competitive plan the ultimate goal must be kept well in mind—namely, not total subscriptions, but 100 per cent participation. Therefore the tally sheets should not record the total subscription, but the percentage of employees taking bonds. This places every department on a more equitable basis for running a race with the other departments.

Undoubtedly the most effective way of keeping these tally sheets is by graphic charts. Fig. 1 shows a suggestion for a company with but one department or where it is decided to hold no intra-company competition. Obviously the idea is to do better in the percentage of employees participating than in either of the first two loans with the bogies set at 100 per cent. This chart should be corrected daily by some authorized person and placed in as conspicuous a place as possible. Those selected to make a personal canvass of employees can make one of their appeals on the basis of the chart.

INTRA-COMPANY COMPETITIONS

If an intra-company competition is undertaken, the chart idea can be carried out much more logically. With one tally master to see that the score is kept right and corrected daily, each participating team or department, or whatever the division may be, is plotted in terms, not of dollars, but of percentage of members subscribing, no matter how small or how large the

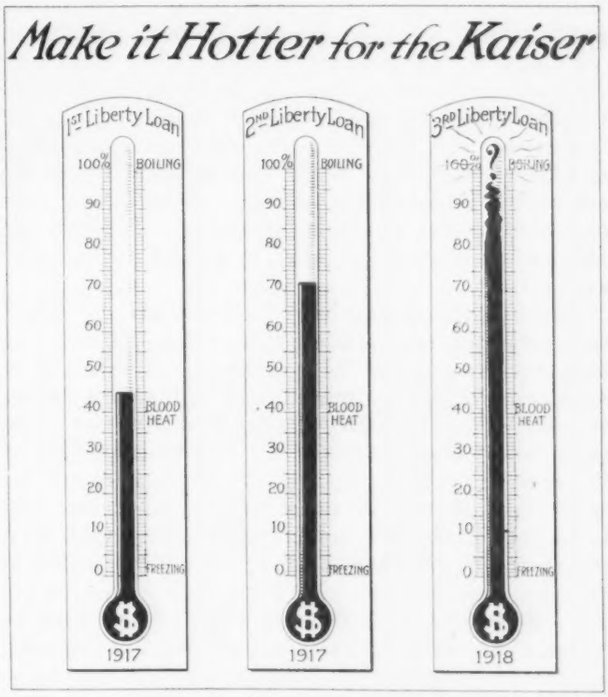


FIG. 2—CAMPAIGN THERMOMETERS HAVE A STIMULATING INFLUENCE

subscriptions. The race then is to see which will first reach the 100 per cent mark, or if none does so, which will stand highest at the end of the campaign.

In this manner a strong feeling can be aroused that will find a ready answer in bond subscriptions. Workmen are not apt to let another department go them one

better, particularly in patriotism, if it can be prevented.

As a further stimulus to a large participation, the employer can afford to allow a bonus of one dollar on every fifty-dollar bond for the members of the first department to reach the 100 per cent mark. Or there are other means. Following the lead set by the national committee, the first department to reach the goal can be presented with an American flag or some similar patriotic token, and this flag or token can be striven for in each succeeding campaign, the holders to keep it until defeated.

Along this same line the thermometer chart usually keeps interest up. In fact, with this type of chart, as illustrated in Fig. 2, the interest becomes more keen as the campaign progresses. As with the other charts, the thermometer method can be used for intra-company competition, using a separate thermometer for each participating team or department, etc. The thermometer is so arranged that the "mercury column" moves upward with the subscriptions.

Besides, the thermometer idea lends itself well to almost numberless catchy phrases embodying the idea of "making it hot for the Kaiser."

In the intra-company competition each participating department should have its own bulletin board showing how the individual members are signing up, and then there should be a master board at some convenient place in the plant or office or shop where the comparative standing of all departments is kept.

As there are only two more weeks left before the campaign starts it is well to see that all preliminaries have been taken care of. (1) Are all committees appointed and do they feel the right enthusiasm? (2) Have arrangements been made for an easily accessible, centrally located Liberty bond desk? (3) Have Liberty loan buttons or other means of designating a subscriber been procured? (4) Are the subscription blanks on hand? (5) Have arrangements been made for bulletin boards? (6) Are the charts or "thermometers," etc., ready? (7) Have arrangements been made for a sufficient supply of Liberty loan literature? (8) In fact, is everybody ready to make the third Liberty loan a 100 per cent success?

Other ways of selling bonds to employees will be described next week, and a plan to steady labor conditions by aid of the Liberty loan will also be described.

Output of Large Generating Systems

Great Growth in Use of Central-Station Energy Shown by Returns from Forty-seven Companies in United States and Canada—Increase More than 4,000,000,000 Kw.-Hr. for Year

THE usual statistics for 1917 on the outputs, peak loads and load factors of the largest generating systems of the country are given on the opposite page. The list has been expanded so that it now contains every generating company in the United States and Canada having an output of more than 100,000,000 kw.-hr. per annum. The aggregate output of the companies listed was 21,000,000,000 kw.-hr., of which the companies operating in Canada generated 3,500,000,000 kw.-hr.

Although the greater part of the electrical energy was generated from water power, it is of interest to note that almost all of the hydroelectric systems having steam reserve stations were obliged to use them during the year. This is indicative of the necessity for further water-power development if our fuel resources are to be conserved. For instance, the great hydroelectric systems on the Pacific Coast had to resort to steam to meet their demands as follows: Pacific Gas & Electric Company, 195,000,000 kw.-hr.; Southern California Edison Company, 144,000,000 kw.-hr.; Southern Sierras Power Company, 7,000,000 kw.-hr.; Portland Railway & Light Company, 23,000,000 kw.-hr.; Puget Sound Traction, Light & Power Company, 5,400,000 kw.-hr.

These statistics show clearly how baseless is the assertion that these systems are overdeveloped hydraulicly. The shortage of hydroelectric energy at Niagara is well indicated by the large output that the Buffalo General Electric Company was called upon to turn out in its steam-driven station, where approximately 130,000,000 kw.-hr. had to be manufactured from coal. The dearth of water power is also indicated in the outputs of the Southern power companies, the Tennessee Power Company turning out by steam over 84,000,000 kw.-hr.; the Alabama Power Company, 41,000,000 kw.-hr., and the Georgia Railway & Power Company, 22,000,000 kw.-hr. Other hydroelectric companies which had to fall back on steam equipment to carry their load were the Adirondack Electric Power Corporation, 51,000,000 kw.-hr.; Rochester Railway & Light Company, 51,000,000 kw.-hr.; New England Power Company, 54,000,000 kw.-hr.; Wisconsin Edison Company, 77,000,000 kw.-hr.; Electric Company of Missouri, 112,000,000 kw.-hr., and the Minneapolis General Electric Company, 75,000,000 kw.-hr., all of which merely confirms the need of further water-power development.

Only one company in the entire list shows a slight decline in output over that of the previous year. All the others show increases, and considering the enormous outputs involved and the handicaps under which the central-station industry was operated during 1917, the showing is phenomenal. All the Canadian companies show large increases, due chiefly to the great demand made for power by war industries. The same is true of many of the Eastern power companies, as, for instance, the Public Service Electric Company, Detroit Edison Company, Philadelphia Electric Company, Cleveland Electric Illuminating Company and the Consolidated Gas, Electric Light & Power Company.

It will be appreciated that there is some duplication in the returns of some of the companies which purchase energy from other sources and include the purchased energy in their returns. For the sake of convenience, similar statistics for the years 1915 and 1916 are published side by side with the statistics for 1917.

DATA ON OUTPUT AND LOAD FACTOR OF LARGEST GENERATING SYSTEMS IN AMERICA

(This includes all companies in the United States and Canada having yearly outputs in excess of 100,000,000 kw.-hr.)

System	1917				1916				1915			
	Peak Load (Kw.)	Date of Peak Load	Yearly Output (Kw.-Hr.)	Yearly Load Factor (per Cent)	Peak Load (Kw.)	Date of Peak Load	Yearly Output (Kw.-Hr.)	Yearly Load Factor (per Cent)	Peak Load (Kw.)	Date of Peak Load	Yearly Output (Kw.-Hr.)	Yearly Load Factor (per Cent)
Commonwealth Edison Company	392,330	Dec. 28	1,488,080,000	44.6	369,740	Dec. 19	1,341,964,000	43.20	337,900	Nov. 29	1,198,636,900	42.50
Niagara Falls Power Company†	152,340	Aug. 1	1,188,221,770	88.97	143,360	Nov. 24	1,015,525,680	80.64	126,320	Dec. 27	899,427,550	81.28
Ontario Power Company of Niagara Falls	123,500	Nov. 11	990,086,100	91.5	123,900	Oct. 12	942,221,900	86.80	.....	.....	757,713,600	.....
New York Edison Company & United Electric Light & Power Company	278,097	Dec. 12	954,913,584	39.2	254,824	Dec. 20	856,385,319	38.30	239,416	Dec. 6	740,873,162	35.30
Montana Power Company	147,712	Jan. 11	947,732,014	73	149,740	Dec. 19	867,940,326	84.50	89,000	Dec. 20	489,831,218	84.10
Montreal Light, Heat & Power Company	152,665	Nov. 12	946,832,817	70.8	.....	.....	.....	.....	.....	.....	.....	.....
Hydraulic Power Company	113,665	June 9	871,563,138	87.6	89,275	Dec. 26	717,079,320	91.50	87,395	Dec. 16	695,619,456	91.00
Pacific Gas & Electric Company	158,272	Nov. 27	854,099,030	61.6	141,008	Dec. 19	768,304,907	62.20	139,540	Dec. 1	725,715,620	59.40
Toronto Power Company	118,000	Dec. 14	800,638,000	84	129,000	Dec. 20	660,873,579	58.40	102,000	Dec. 29	348,000,000	39.00
Southern California Edison Company	166,755	Oct. 11	794,687,405	54.4	60,930	Dec. 28	299,950,513	56.04	56,625	July 13	286,985,095	57.80
Public Service Electric Company	181,500	Nov. 27	734,665,649	46.20	174,000	Dec. 14	608,018,729	39.82	143,000	Dec. 10	490,684,988	37.73
Detroit Edison Company	152,300	Nov. 27	672,200,600	50.4	130,200	Dec. 19	546,925,300	47.80	101,800	Dec. 17	393,129,850	44.10
Shawinigan Water & Power Company	119,000	Dec. 21	633,573,610	60.4	108,000	Dec. 14	478,540,000	50.00	*	.....	.....	.....
Philadelphia Electric Company	148,931	Nov. 20	600,583,589	46.0	142,260	Dec. 12	444,785,884	35.6	*	.....	.....	.....
Duquesne Light Company	125,000	Nov. 9	592,575,925	54	101,000	Dec. 21	463,537,660	52.30	83,000	Nov. 29	347,514,317	48.00
Tennessee Power Company	85,200	June 15	547,945,475	73.41	81,650	Dec. 14	483,354,162	67.00	*	.....	.....	.....
Pennsylvania Water & Power Company	86,000	.....	516,891,000	68.6	77,000	.....	417,837,600	61.8	76,000	Dec. 12	.....	51.90
Utah Power & Light Company	79,011	Dec. 21	502,183,000	72.5	68,894	Dec. 6	412,726,000	67.8	.....	.....	.....	.....
Mississippi River Power Company	86,400	Oct. 31	476,500,000	63.0	82,400	Nov. 27	393,400,000	54.3	77,300	Nov. 18	370,330,660	54.60
Great Western Power Company	74,900	Oct. 6	457,998,635	71.13	74,100	Dec. 14	408,391,067	62.65	62,100	Nov. 15	337,264,400	62.00
Cleveland Electric Illuminating Company	113,228	Nov. 27	444,735,309	45	84,999	Oct. 25	340,670,721	45.8	*	.....	.....	.....
Buffalo General Electric Company	95,400	Dec. 6	440,596,100	52.7	65,500	Dec. 14	328,412,550	57.00	62,460	.....	.....	.....
Puget Sound Traction, Light & Power Company	83,800	Dec. 21	396,600,000	54.0	77,030	Nov. 28	353,697,263	51.8	66,000	Dec. 30	273,950,000	.....
Consumers' Power Company	94,235	.....	380,570,917	46	.....	.....	315,964,337	.....	66,930	Dec.	295,766,712	51.20
Electric Company of Missouri	92,300	Dec. 6	376,891,756	46.5	88,544	Dec. 11	333,964,652	43.1	76,303	Nov. 29	245,300,654	52.50
Union Electric Light & Power Company											308,759,186	42.60
Consolidated Gas, Electric Light & Power Company	69,980	Dec. 4	343,723,580	62.4	55,620	Dec. 11	249,836,310	59.1	40,580	Dec. 20	171,095.74	55.0
New England Power Company	71,500	Oct. 30	300,600,000	48	64,000	Dec. 12	246,000,000	44.00	49,300	Dec. 29	172,863,764	40.05
Alabama Power Company	58,250	Nov. 14	289,715,125	56.7	40,500	Dec. 11	184,345,360	51.07	28,750	Dec. 21	123,882,040	48.00
Wisconsin Edison Company	71,106	Nov. 30	275,566,740	44	64,170	Dec. 5	218,421,711	39.00	52,458	Nov. 19	158,089,543	35.00
Milwaukee Electric Railway & Light Company												
Edison Electric Illuminating Company, Boston	83,966	Dec. 19	265,430,474	36.1	80,539	Dec. 12	239,557,144	33.72	72,802	Dec. 13	208,358,400	32.70
Georgia Railway & Power Company	78,200	April 24	258,607,882	.....	72,600	Mar. 17	211,872,638	.....	77,100	Dec. 17	179,976,596	26.65
Edison Electric Illuminating Company, Brooklyn	78,000	Dec. 19	255,912,300	37.5	67,200	Dec. 19	233,452,500	38.1	62,000	Dec. 23	188,516,851	34.70
Pacific Light & Power Corporation	‡	.....	.....	.....	82,765	Dec. 22	376,308,731	51.76	76,150	Oct. 28	316,098,189	47.39
Minneapolis General Electric Company	54,940	Dec. 6	222,146,210	46.16	43,640	Dec. 14	171,672,890	44.9	33,100	Dec. 6	128,941,588	44.50
Portland Railway, Light & Power Company	50,620	Dec. 31	218,086,315	49	47,335	Nov. 29	194,146,555	46.5	47,150	Dec. 30	186,372,553	45.10
Sierra & San Francisco Power Company	45,270	Jan. 11	196,069,588	49.44	.....	.....	191,620,000	.....	40,560	Feb. 26	190,147,804	53.50
Washington Water Power Company	36,707	Dec. 20	188,311,100	58.5	30,440	Dec. 14	162,825,400	60.80	28,691	Jan. 20	165,913,500	66.00
Great Northern Power Company	40,000	Oct. 24	180,583,920	51.5	38,200	Nov. 21	163,807,560	48.8	32,000	Nov. 23	142,249,020	50.80
Rochester Railway & Light Company	42,154	Dec. 13	162,490,264	44	40,250	Dec. 16	146,069,428	41.00	37,000	Dec. 15	123,401,451	38.00
Toledo Railways & Light Company	37,627	Dec.	162,061,232	49.4	36,428	Dec. 22	134,842,360	42.2	33,370	Dec. 31	100,168,375	.....
Adirondack Electric Power Company	42,000	Dec. 7 & 14	158,570,164	43.1	41,575	Dec. 12 & 22	151,128,310	41.40	38,400	Dec. 13 & 29	128,640,000	38.20
Virginia Railway & Power Company	37,000	Dec. 18	153,128,026	47.39	33,900	Dec. 18	132,275,000	44.54	*	.....	.....	.....
Southern Sierras Power Company	25,900	Aug. 9	148,267,885	65.3	22,400	April 28	131,084,265	66.5	20,300	July 21	114,187,385	64.20
Nevada California Power Company												
Potomac Electric Power Company	44,800	.....	140,762,646	36.09	38,600	Dec. 18	122,158,818	36.1	36,200	Nov. 30	111,082,725	35.03
Southwestern Power & Light Company	31,500	Nov. 17	126,396,800	46	25,600	Oct. 5	95,740,000	43.0	16,600	Dec. 22	87,089,000	44.00
Southern Power Company	‡	.....	.....	.....	*	.....	.....	.....	.....	.....	.....	.....
Empire District Electric Company	23,000	April 1	105,487,860	52.4	26,900	Mar. 26	119,280,363	49.7	*	.....	.....	.....

*No data received.

†Includes Canadian Niagara Falls Power Company.

‡Consolidated with Southern California Edison Company.

STATION & OPERATING PRACTICE

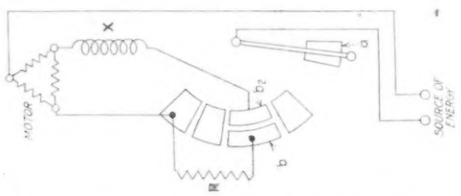
A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

CAUSE OF TROUBLE WITH SINGLE-PHASE STARTER

Often Due to Poor Contact Between Moving Contact and Stationary One Connected with Resistance and Reactance

BY E. C. PARHAM

When trouble with single-phase starters having connections like those shown herewith occurs it will usually be found that the contact a fails to touch both b and b_1, or that there is an open circuit in the leads between



SIMPLIFIED DIAGRAM OF SINGLE-PHASE STARTER CONNECTIONS

these contacts and the motor. Failure of a to make contact with either b or b_1 may be due to a weak spring or blistered contacts. If any of the faults mentioned exist, the production of a split-phase for starting the motor is prevented.

THE SYSTEM LOAD FACTOR VERSUS STATION LOAD FACTOR

Study of Operating Conditions in an 18,500-Kw. Turbine Plant—Cost of Coal and of Hydroelectric Energy

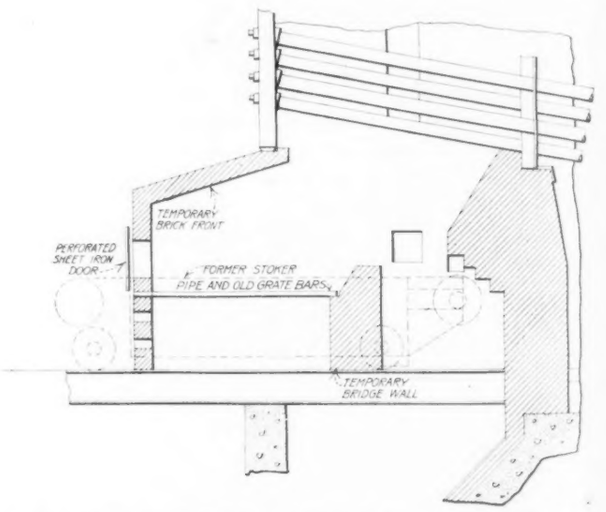
In making up operating data from central stations where energy is purchased in considerable part a distinction should be made between the system load factor and the station load factor. A study of operating conditions in an 18,500-kw. turbine plant producing 40,507,750 kw.-hr. in 1917 was recently completed. The yearly load factor of the station on the basis of an average output of 4625 kw. and a maximum peak of 14,000 kw. was 33 per cent. Incidentally the coal consumption per kilowatt-hour was 2.64 lb. (1.197 kg.) and the net cost of production at the busbar was 9.21 mills for locally generated energy. Coal cost 5.73 per ton at the plant, with rail delivery, and bituminous coal of high grade was burned under boilers equipped with mechanical stokers.

This company, however, purchased 10,670,650 kw.-hr. from a hydroelectric system traversing the State, so that the average load on the system was increased to 5850 kw. and the load factor, assuming a common point of supply, was raised to 41.6 per cent. The net cost of delivery of each kilowatt-hour to the system from the local plant and from the wholesaler of energy was $429,571, or practically 8.5 mills per kilowatt-hour. The hydroelectric energy supplied cost about 5.3 mills per kilowatt-hour. The central-station interchange contract with the hydroelectric company resulted in the sale by the former to the latter of 365,400 kw.-hr., at 8.05 mills per unit; but in the main the supply of energy from the water-power system was sufficient to make it necessary to furnish supplementary service only occasionally.

OPERATING A FURNACE WHILE MENDING STOKER

Chain-Grate Stoker Is Backed Out and Temporary Bridge Wall and Brick Front Constructed to Permit Firing

In the power houses of one of the Illinois state institutions where inmates were used as firemen, two 400-hp. stokers failed completely owing to the warping of the shaft at the rear ends of the grate. These stokers were backed out of the furnaces and temporary bridge walls and temporary fronts of brick were placed as shown in the accompanying illustration. Old plain grates secured from other inoperative plants were secured and laid on this foundation of brickwork so that the boilers could be fired by hand through an opening left in the brick front. This opening was closed when



PIPES RESORTED TO FOR GRATE BARS WHILE AWAITING REPAIR PARTS

the men were not firing by a perforated piece of sheet iron which had holes enough in it to keep it from getting red hot.

While the foregoing method of repairing and operating a boiler is not recommended for prolonged service, it did meet an emergency and kept the plant running until the delayed repair parts were received and placed in service.

ESTIMATED TOTAL COST OF SEMI-OUTDOOR SUBSTATION

Consists of an Outdoor Transformer Station and an Indoor Converting and Distributing Station—Will Energize City Street Railway

In the accompanying table the estimated total cost is given of a semi-outdoor substation now approaching completion in Massachusetts for the supply of energy to a Springfield urban street railway from the Turners Falls Power & Electric Company system at 66,000 volts.

TOTAL COST OF SEMI-OUTDOOR SUBSTATION IN MASSACHUSETTS

OUTDOOR TRANSFORMING STATION	
Two 6000-kva., 66,000-13,200-volt transformers ($2.08 per kva.)	$25,000
Two 66,000-volt lightning arresters	5,000
Four 66,000-volt oil switches	10,800
Seven 66,000-volt disconnecting switches	1,400
Foundations for equipment	2,000
Copper tubing and insulators	1,174
Water pumps, tools and piping	7,000
Labor of installation	2,100
Engineering and contingencies, 20 per cent	10,894
Total	$65,368
INDOOR CONVERTING AND DISTRIBUTING STATION	
Building and foundations, 50 ft. by 70 ft.	$50,000
Three 1500-kw. motor-generator sets ($22.22 per kw.)	91,000
Switchboard, thirty-six panels	25,800
Wire, cable and conduit	15,000
Labor of installation	5,500
Engineering and contingencies	37,460
Total	$224,760
Grand total ($24.18 per kva.), initial transformer capacity	$290,128

The exterior equipment includes two 6000-kva. transformers and necessary oil switches, "disconnects" and auxiliary equipment, with lightning arresters mounted on concrete bases in the substation yard. Inside a brick and concrete substation building are three 1500-kw. motor-generator sets, receiving energy at 13,200 volts alternating current and delivering direct current at 600 volts to the local trolley lines.

RELIABILITY OF METHODS OF TESTING GROUND RESISTANCE

Bureau of Standards Opposes Lamp-Bank, Fuse, Single-Voltameter and Magneto Methods of Testing and Recommends Kohlrauch Bridge

After a series of extended experiments on testing the resistance of ground connections, the Bureau of Standards has come to the conclusion that most of the methods commonly used do not give correct results. Dependable results can be obtained by use of the ammeter-voltameter method when a proper selection of instruments is made. The disadvantages of this method, however, are the non-practicability, the possible absence of energy supply, the amount of calculation required and the necessity for two auxiliary grounds or one of assured low resistance. If a potential as high as 100 volts is available, direct current may be used as efficiently as alternating current, but this method must be discarded if other ground connections than those to be investigated exist.

A direct-reading, portable, rugged and fairly reliable means of testing the resistance of ground connections is found in the use of the Kohlrauch bridge method or a modification of it. A separate source of energy may be obtained from a dry cell, and two auxiliary grounds must be available. Actual practice shows that the Kohlrauch bridge method checks with the ammeter-voltameter method to within an average of 3 per cent. The error very seldom approaches 10 per cent.

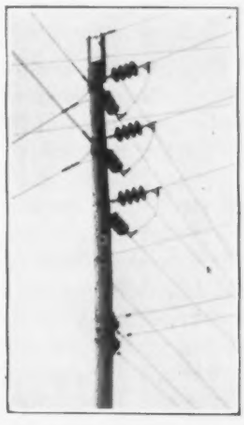
The present-day methods of ground testing used by many electric companies have been found very unreliable. These methods consist chiefly of the lamp-bank, fuse, single-voltameter and magneto methods. The results by these methods are not even approximately correct. The single-voltameter method gives a degree of accuracy that depends largely upon the resistance of the voltameter and possible fluctuations in the voltage of the line.

An extensive study of the effect of high voltage upon the electrode and the surrounding soil showed that the energy liberated at first causes the resistance to decrease about 20 per cent. If the critical value is reached, the soil will commence to dry out and an increase of resistance will follow. It is necessary, therefore, to read the meters immediately on the closing of the circuit.

INEXPENSIVE CORNER FOR LINE WITH MANY TURNS

Right-of-Way Difficulty Solved by Designing Special Inexpensive Type of Corner Construction

The 33,000-volt, three-phase transmission-line corner construction shown in the photograph reproduced herewith was designed especially for a 12-mile (19.3-km.) line in which there are seventeen turns. When the right-of-way was being purchased it was found necessary either to follow this devious route or to pay exorbitant prices for pole rights for a straight run between the plant and end of the line. According to the engineering estimates, this type of corner is about 75 per cent cheaper than a two-pole corner and is approximately 70 per cent cheaper than a buck-arm corner of single-pole construction. The guying for any one of the three types of corners would be practically the same, but the large difference in cost would come in the reduced labor and material charges entering into the construction at the top of the pole.



TURNING CORNER ON STRAIN INSULATORS SAVES EXPENSE

REMOTE-CONTROL AIR-BREAK SWITCH OF INEXPENSIVE TYPE

Operating Force Imparted by Weight, and Control Impulses Are Electric—Details of the Method of Construction Followed

The San Diego Consolidated Gas & Electric Company has recently utilized remote-control mechanisms to operate air-break switches employed on its 11-kv. distribution lines. Type 1420, style 5008, made by the Pacific Electric Manufacturing Company and rated at 100 amp., 20 kv., are used. The operating handle has been replaced, however, with a distant-control mechanism mounted in a box on the pole, the operating force being imparted by a weight and the control impulses by electricity.

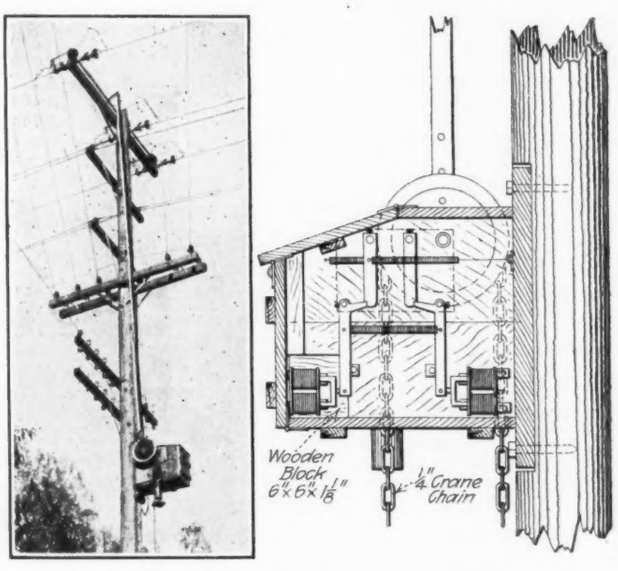
As the switch mechanism is designed primarily for use as switching centers on long suburban 11-kv. feeders, in districts where the only available supply of energy is from the very feeder to be controlled, it was seen at once that motor or solenoid operated mechanisms were out of the question, since the expense of an auxiliary source of supply would be excessive, while if such supply were not furnished, the switch might prove inoperative because of failure in the line at the very time it was most needed.

The mechanism consists of a cast-iron pulley wheel, to which the wooden switch-operating rod is attached eccentrically and over which the chain supporting the weight is passed. As the operating impulses are imparted to triggers, the wheel is repeatedly released and arrested, and after each impulse is caused to rotate through a half revolution by the weight. With the rod-attachment point in the upper position the switch is closed; when in the lower position the switch is open, the wheel giving the same throw to the rod as would be imparted by an operating lever when switched by hand control.

It will be noted that at the beginning of each movement the motion of the end of the lever is perpendicular to the normal operating motion, which gives the weight an opportunity to gather momentum and apply the necessary force to open or close the switch properly. At the end of the stroke the motion is similarly retarded, and the large spring interposed between the weight and the chain further takes up the jar of the arrested weight. The chain is endless, and consequently the balance is not changed after successive operations. The weight is attached to the chain by a hook device, and the switch is rewound after several operations by detaching the weight and rehooking it to the chain higher up. Six or eight successive operations are possible (depending on pole height) before the switch requires rewinding, this being as many movements as will ordinarily be desired before an opportunity for resetting presents itself. An old arc-lamp reel and pulley is provided and the weight can be raised by one man.

The trigger system is designed to give positive operation with small direct-current impulses. For this reason a double system of levers is employed. The turning movement of the weight is resisted by secondary levers, so that there is very little friction on the primary triggers. After release each lever is returned to position by a coil spring. The tripping mechanism is mounted in a heavy poplar box, with top and end hinged to permit ready inspection. A lineman may trip the switch by hand manipulation of the triggers, or if desired a pair of tripping cords can be run down the pole.

The tripping solenoids are series coils from old arc lamps. A small 24-volt storage battery at the distant control point furnishes the momentary direct-current impulses to operate the switch. A pair of contacts is also provided on the main shaft to operate pilot lamps at the control point, thus affording a return signal to prove the operation of the switch. As the operating current is only momentary and a small switch is provided in the lamp circuit so that the lamps are lighted only during switching or testing operations, the draft on the battery is small and it need be recharged only at considerable intervals. The remote-control operating switch is a double-throw knife switch with positions properly designated "open" or "close." Throwing of the master switch to the wrong position will not affect the tripping mechanism. In order to have the indicating lamps entirely independent of the tripping circuits, five wires are run betwen the switch and the control point. The switch is tested monthly on a Sunday morning, so as to keep all contacts free.



AUTOMATIC AIR-BREAK SWITCH, WITH DETAILS OF OPERATING MECHANISM

The switch was designed primarily for use at important switching centers and test points. For instance, in one case an 11-kv. feeder, after passing through several small towns, spreads out over an extensive agricultural district covered with many line hazards in the way of trees, river crossings, brush-fire hazards, etc. A switch of this type is installed beyond the largest town, and the control is installed in the home of the district troubleman near by. In case of trouble on the feeder the line may be quickly sectionalized at this point, and if the trouble is beyond in the agricultural district, as is usually the case, service may be immediately restored over the more important part of the circuit. Considerable time is saved, particularly at night, over the old hand operation, and if the troubleman is absent on his regular duties, his wife may be called on in emergency. In quickly restoring service and in line testing this non-automatic switch is a great improvement over fuses, and in fact it practically replaces a far more expensive automatic oil switch.

CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

EDUCATING WOMEN IN CENTRAL-STATION WORK

Meeting in Los Angeles Shows Method Adopted for Giving New Help a General Knowledge of the Business

That women are more and more making a place for themselves in the conduct of public utility business is recognized. Of late the war has called so many men that women have been forced into utility work that they would probably otherwise have had difficulty entering for years. An evidence of how women are beginning to take hold and how they can quickly be given a general knowledge of the business is contained in the following report of a meeting of 150 women employees of the Southern California Edison Company, Los Angeles, which was held a short time ago. Those who were present are employed in the company's offices in Los Angeles and the adjacent cities. Probably 100 of the company's woman employees were not able to attend on account of distance or other reasons. Only seven or eight men were invited, and they were officers of the company.

The object of the gathering was to inaugurate a series of meetings to be held at regular intervals by the company women, and it is the intention to invite to each meeting one or more officers or department heads, who will address the women on subjects which are to be agreed upon later, but all pertaining to the affairs of the company and the best way to handle them. Miss Gertrude Tucker presided, and in her opening remarks explained that many vacancies had occurred in the executive, commercial and engineering departments during the past year because of the war and that a considerable number of these positions had been filled by bringing into the organization many capable women. Woman's work in the company was increasing every month, not only because of the greater number of women employed, but also because women were filling some positions which had heretofore been reserved exclusively for men.

These meetings are for the purpose of informing the newer women employees as to the history and traditions of the company and educating them as to the company's responsibilities, aims, ambitions and expectations. At future meetings one of the officers will tell of the number and variety of companies which have been consolidated in past years to make the Southern California Edison Company of to-day. Another will tell where the power comes from and where it goes to; another will explain where the money comes from and where it goes to, and still another will tell where the 175,000 consumers are and how they are looked after. Others will discuss such matters as departmental work, taxation, regulation and kindred subjects—all to be treated in an interesting, understandable and non-technical manner.

THE CREDIT DEPARTMENT'S RELATION WITH CUSTOMERS

Methods Adopted by Large Utility for Obtaining Credit Information and Light and Power Deposits

When every dollar means so much, when losses must be minimized, the necessity for stricter credits becomes apparent. The credit department of a central-station company therefore occupies a much more important position than formerly. Strict methods calculated to keep down losses are all the more desirable. Such methods are outlined in the following statement showing how a large Middle Western utility takes care of its customers' credits.

Two Classes of Contracts

Commercial contracts are received in the credit department from the contract department, and on receipt are stamped on a receiving time stamp showing the exact time of arrival in the department. They are then checked off in a receiving book, which is an index as to whether or not the contracts have been received or are being held in the department. The credit slip attached to each contract then receives a number similar to the contract, by which it can be identified later on should it become necessary to refer to it. After a careful examination of the signature on each is made, the contracts, which may be divided as class 1 and class 2, are handled in the following manner:

Class 1—Applications from those claiming to be former consumers and giving address of former location as reference. The account is looked up to ascertain the customer's habit of pay and to find out whether the account is paid up to date. If the investigation proves satisfactory, the application is passed without further delay. If, however, the customer has paid penalty month after month, or if it has been necessary to cut off his service in order to force payment, a deposit for the new address is required.

When a deposit is necessary the customer is so notified by letter and the application is held pending its receipt. Upon receipt of the deposit a deposit certificate is issued and mailed to the depositor and the application is approved for service. When more than the current bills at the previous address are found owing a statement is sent the customer, with a letter notifying him that no service will be given until payment is made. The account in arrears is noted "Notify credit department when paid," so that in the event of the payment crossing the letter in the mail, the bookkeeper will advise of receipt of payment at once and thus avoid unnecessary delay. The application is filed in the holding file, and no service given, until account is paid.

Class 2—Applications from those claiming never to have used company's service. This class of applications

is looked up in the suspense file to ascertain whether the applicant has not overlooked a previous address where service has been used and a balance remains unpaid. If the suspense file discloses such an account, the applicant is advised by letter of such indebtedness and payment requested, the application being held and no service given until payment is made.

Duplicate Copies of Applications

When the suspense account discloses no indebtedness, rating books are consulted, in some cases special reports from the rating agencies are obtained, or references offered as to the responsibility and credit standing of the applicant are investigated. Should the investigation prove unsatisfactory, a deposit is requested which is equal to two months' bills, the amount of the bills being estimated by installation, location and class of business. This deposit is requested by letter and the application filed in the holding file until received.

Owners of real estate in good standing are passed after claim of ownership has been verified. Applicants who object to making a cash deposit can furnish a guarantee from a real estate owner in good standing, or from a responsible business man, guarantor being required to sign a form adopted for this purpose.

A duplicate copy of all resident applications taken in the contract department is received in the credit department each morning. On these applications the service has been given before the credit has been passed so as not to inconvenience the applicant while credit is being investigated. On receipt of these duplicate copies of the application the same routine is followed as with the commercial contracts. When deposits are required which the applicant refuses to pay service is disconnected and the meter removed in a manner to be explained further along.

All letters requesting a deposit or unpaid balance have two carbon copies. One of these copies is attached to the application and filed in the holding file and the other is filed in an every-day file seven days after date. When these copies are reached they are checked with the holding file, and in all cases where the request has been complied with the copies are destroyed, but those from whom there has been no reply receive a second letter calling attention to the first one and requesting a reply. These second letters also have two copies, one of which is attached to the application and returned to the holding file and the other placed in the every-day file seven days ahead. If no response is had to this letter at the end of seven days, the application is removed from the file, and if the applicant has no service at the new address it is canceled and returned to the contract department.

Where a deposit is found to be necessary from applicants for commercial lighting who move into a location where light is already installed and in use, and for all resident applications where service has been turned on before credit is investigated, a shut-off notice is made out at the time the first deposit letter is written. This shut-off order instructs the shut-off collector to call and obtain the deposit or disconnect the service. When the collector calls, unless deposit is received or a good reason given for its not being made, or satisfactory information as to the applicant's credit standing given, service is discontinued. These cut-offs are held ten days, and if the applicant does not call or make some attempt to satisfy credit, the meter is ordered removed. When the repair department reports back that the meter has been removed the application is canceled and returned to the contract department.

In all cases where commercial applications are held in the credit department the contract department is notified at once why application is being held, and in cases where the applicant is the successor and the service has not been discontinued for the predecessor a status slip accompanies the notice requesting that the successor be billed from the date of his application.

When a final bill is rendered and not paid a statement is made out in duplicate by the collection department and a duplicate copy is sent to the credit department, where a record is taken of it on a card and the card then filed in the suspense file. Where the delinquent is a corporation or partnership the credit slip received with the contract is referred to, and the officers' or partners' names and addresses are ascertained and a card made in each of their names, with a notation thereon to refer to the card for the company of which they are members. The duplicate statement is then stamped "Suspense" and returned to the district head in charge of collections, to be used as a check on the collector. The statement is then worked by the collector, and a report of his calls and their results is noted on the reverse side. Should the statement be collected or paid at the office, the statement is returned to the credit department so noted, and the card is withdrawn from the suspense file and destroyed. Should the account prove uncollectible and it be found necessary to send to an attorney, the statement of the collector, with his reports noted thereon, is returned to the credit department and any information of value obtained by the collector is transferred to the suspense card to aid in the collection of the account later if opportunity arise.

The value of the suspense file depends in large measure on obtaining the applicant's full first name. If the customer insists on signing the first initial only, he may be allowed to do so, but effort is made to find out what the initial stands for and to note this on the application. The number of suspense cards made out and filed by this company averages approximately 3500 per month, and the average monthly revenue obtained from this file during the past year amounted to $800, or almost $10,000 in the course of the year.

Handling Merchandise Sales Orders

Merchandise sales orders are handled as are light and power applications. Many firms are trading on open account with this company, and some accounts must be watched closely, letters being continually written requesting payment on slow accounts, and in a few cases credit being stopped completely pending settlement.

A card file is kept in the department showing customer's name, service location, date signed, the predecessor's name if it is a successor application, the name of the company's agent obtaining the business, and the order number of the contract, which number agrees with the number on the credit slips. Another file is kept which shows all deposits of record, by whom made and for what address, and still another file for line extension advances, which are taken by the credit department and either applied on the light and power account, if the customer is a consumer, or transferred by journal entry to a holding account.

SALES BULLETIN FOR ALL THE EMPLOYEES

Sheet Designed to Help Those in Every Department to Turn in Domestic Business on Commission Basis

In its endeavor to increase the sale of electrical energy in the home through a more liberal use of appliances the Public Service Company of Northern Illinois has started publishing what is known as the *Public*

PUBLIC SERVICE

SALES BULLETIN

Issued by the Sales Department for the Sales Instruction of Company Employees — Public Service Company of Northern Illinois, 72 W. Adams St., Chicago, Ill.

VOL. 1 FEBRUARY 15, 1918 NO. 1

ANNOUNCEMENT OF NEW SALES POLICY

Company to Pay Commission on Sales

Ladies and Gentlemen:

Meet Mr. Incomebooster.

This energetic little man, whom you see at your left, represents a commission of 5%, which the Company will pay you on Gas and Electric Appliance Sales which you make. Now, just a moment.

Don't all speak at once!

We know you are not in the Sales Department; and, that this is not a part of your work; and that you have had no experience in selling; and all that.

To begin with: It is not expected that you will neglect your regular duties to do sales work. This plan is based on the proposition that each one of our 2,000 employes has a certain number of friends, and neighbors, who are customers of the Company, and who they come in contact with from time to time.

If you will only take advantage of this opportunity to call their attention to one or more of the many gas and electric labor saving devices we have for sale, you will be surprised to see, "How easily a sale is made." And after each sale, Mr. Incomebooster will come across with the 5%.

You as to Experience:

The best salesman that ever lived, began without experience. His experience came only after repeated effort. Who can say but that in our organization of 2,000 employes, there are many potential salesmen and saleswomen.

Now is your chance to demonstrate your sales ability, and incidentally add to your bankroll.

Opportunity in the person of Mr. Incomebooster is knocking at your door. It is up to you to let him in.

Inspiration is more likely to strike a busy man than an idle one.

Hustle will get you more than heartburn.

Don't wait for opportunity—Go after it.

THE ELECTRIC IRON

The electric iron is by far the most popular of all the electric labor saving devices found in the home today.

This fact is attested by the hundreds of thousands in daily use.

There were at least 7,000 electric irons, with an estimated revenue of $35,000.00, added to our lines during the past year.

Do you realize what it would mean if each of our 2,000 employes, exclusive of our stores, sold but five irons each during the present year? Not an impossibility by a long shot. Let's try it anyway. Suppose we fix upon that number.

Not as a goal but as a minimum of the number of electric irons we will sell during the present year.

You yourself (another with the electric iron) sold will have no trouble at selling it. Our terms of One Dollar down; and One Dollar per month, make it extremely easy for you.

The retail selling prices of electric irons are as follows:

Hotpoint—6 lb. iron, complete $5.00
General Electric—6 lb. iron, complete 5.00
American Beauty—6½ lb. iron, complete 9.00

If the customer wishes, she can turn in, from one to four of her old style sad irons, and receive a credit of 25c each on the purchase price of a new electric iron.

Or, if the customer wishes to turn in her old electric iron we will allow her a credit of $1.00 on the purchase price of a new electric iron.

This, however, will not affect your commission, as you will receive compensation based on the regular retail price of the iron.

Start your selling campaign with the electric iron, and after you find how easy they are to sell, you will have more confidence in trying the other appliances.

THE SALES BULLETIN

In the succeeding issues of the Sales Bulletin, which will be sent you from time to time, we will endeavor to furnish you such information as will aid you in turning your prospects into sales.

The bulletin will contain short articles, descriptive of the gas and electric appliances we have to offer. Sales arguments, prices, terms, etc.

If you will save your copies of the bulletin you will soon have a volume of information for ready reference.

You will note that the bulletin is of the proper size to readily file in an ordinary letter-file.

It is important that you save your copies of the bulletin, as it will be impossible to supply you with duplicates.

Be a Live Wire and you won't get stepped on. It is only the dead ones that are used for door mats.

SALES BULLETIN ISSUED MONTHLY FOR THE INFORMATION OF EMPLOYEES

Service Sales Bulletin. This one-sheet folder will be published monthly and will be distributed with the pay envelopes of the employees. The first issue contains an announcement that the company will pay a commission of 5 per cent to its employees on all appliance sales.

The rules governing the payment of these commissions to employees are as follows: All employees are eligible except division superintendents, assistant division superintendents, gas salesmen, industrial gas salesmen, electric salesmen, electric power salesmen and sales clerks in sales rooms. The commission of 5 per cent will be paid to all other employees on retail sales of gas and electric appliances, except gas ranges, gas mantles, incandescent lamps, fans and automobile-charging outfits, for use in the homes of customers of the company. The commission is payable as soon as the customer pays for the appliance, and in the case of deferred payment sales as soon as the customer has made the second payment. The commission will be paid monthly on or about the fifteenth of the month following the sale. The employee must obtain a signed order in duplicate from the customer on a form provided for the purpose. The employee must make sales during his spare time or after the company's regular business hours. Employees must find their own customers; if they are unable to close the sale, they may, if they so desire, ask the division salesman for assistance, and by mutual agreement divide the commission in such cases. Appliances will not be placed on trial.

HYDROELECTRIC COMPANY ADVERTISES FUEL SAVING

Interesting Circular Points Out the Way in Which One Company in 1917 Saved 300,000 Tons of Coal

The Southern Sierras Power Company of California, in a concise circular entitled "Electricity's Part in Fuel Saving," recently gave its customers some interesting data on the saving which water power has made and can make in the amount of commercial fuel used in California. A copy of the circular distributed to the customers is shown herewith. It points out that in 1917 the Southern Sierras Power Company and associated companies generated 148,267,885 kw. of electrical energy, all but 6 per cent of which was water-generated, and in so doing eliminated the necessity of the same power consumers using 300,000 tons of coal which it would have required 7500 coal cars to transport. The circular also points out that if the company's 11,000 consumers used electricity for cooking the saving in coal would amount to 150,000 tons annually.

ELECTRICITY'S PART IN FUEL SAVING

So serious is the coal shortage throughout the United States that it has become the patriotic and imperative duty of each individual to aid to the utmost in the conservation of commercial fuel.

This can best be done by the use of electricity, generated solely by water power, which has the recommendation and approval of the government.

The generating of hydroelectrical energy requires no fuel.

Even the water turning the wheels of the enormous power plants operated by this company is not consumed or contaminated, but returns at once and without diminution to its natural channels. During the year 1917 the Southern Sierras Power Company and associated companies generated 148,267,885 kw.-hr. of electrical energy (all but 6 per cent of which was water-generated), which in its many uses is doing work in the mines, factories, farms and homes of this great Western territory that otherwise would have necessitated the use of 300,000 tons of coal. It would have required 7500 coal cars to have transported this vast quantity of coal to the consumers.

To curtail your use of electric service, or to fail in utilizing electricity to the very fullest extent in business and in your home, is to fail in doing your full share to support the government's fuel conservation policy.

There are many uses in every business and in every home for electric service where a direct and material saving of coal will result.

Electric cooking and electric ironing are important factors.

In residences, hotels and restaurants throughout this company's territory electric service is being used to-day for cooking, and by using electricity for this purpose these consumers are saving the government an equivalent amount of coal annually.

If our 11,000 consumers used electricity for cooking, the saving would be 150,000 tons of coal annually.

In practically every industrial pursuit in the West electricity is simplifying production, abolishing wasted effort, increasing production, cutting operating costs—and SAVING FUEL.

THE SOUTHERN SIERRAS POWER COMPANY

TECHNICAL THEORY & PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Periodical Insulation Tests.—P. M. LINCOLN.—The article contains replies from twenty-five out of about eighty electric service companies in twenty-seven states to the following questions: What companies apply potential tests to the insulation of their generators and other similar apparatus? (2) How frequently is such a potential test applied? (3) What test voltage is applied (measured in terms of normal operating voltage)? The main information was contributed by the Commonwealth Edison Company, the Niagara Falls Power Company, the Interborough Rapid Transit Company of New York City, the Edison Illuminating Company of Brooklyn and the Philadelphia Rapid Transit Company. Of the eighty replies received, seventy-five admitted more or less frankly that no attempt has been made to apply periodical high-potential tests to generator apparatus for the purpose of determining the condition of the insulation after the apparatus has once been placed in service.—*Electric Journal,* March, 1918.

Essentials of Transformer Practice.—E. G. REED.—Seventh installment of a series of articles on this subject. In the article the author discusses the initial rate of temperature rise, temperature gradient between windings and oil, heating and cooling curves, overload temperature-rise curves, and safe maximum operating temperatures.—*Electric Journal,* February, 1918.

Generation, Transmission and Distribution

Ground Connections for Distribution Systems.—W. C. HESTON.—The great cost of the prescribed ground for overhead distributing systems led a Portland company to experiment with various types of ground to see whether a less expensive method might not be found which would meet requirements. The results of these comprehensive tests and the conclusions drawn from them are presented in the article.—*Journal of Electricity,* March 1, 1918.

Long-Distance Transmission in Germany.—(Abstracts from data given by F. Niethammer in a recent issue of *Elektrotechnik und Maschinenbau.*) The author gives some particulars of the generation of electricity in Germany, which in 1916 amounted to 10,000,000,000 kw.-hr., as compared with 2,600,000,000 kw.-hr. in 1913, and discusses a possible electric network covering the entire country. The potentialities of water power are being much appreciated in Austria and Germany, and schemes are being promoted for the utilization of a large part of the power to be derived from waterfalls in the Austrian Alps. It is also stated that in the near future Germany aims at the complete electrification of all her railways and the erection of supergenerating stations using power derived both from water and from the exploitation of her large fields of turf and bituminous coal. A still further development in the general industrial use of electricity in large cities for heating, lighting and power is considered probable.—London *Electrician,* Feb. 8, 1918.

Combustion of Coal and Design of Furnaces.—HENRY KREISINGER, C. E. AUGUSTINE and F. K. OVITZ.—After several years of experiments in fuel combustion in a special furnace the Bureau of Mines, Department of the Interior, makes the announcement that from the results it has obtained it is possible to design a furnace with considerable more assurance as to its capabilities than has heretofore been possible. The process carried on in the combustion space is influenced by many factors, the most important of which are the volume and shape of the combustion space, the kind of coal used, especially the character and amount of volatile matter it contains; the rate of firing, the quantity of air supplied over the fuel bed, the rate of mixing the air with the combustible rising from the fuel bed, the rate of heating the coal, and the temperature in the combustion space. The qualitative effects on the rate and completeness of combustion of many of these factors have been known for a long time, but the quantitative data, presented in definite units of seconds, pounds, feet or percentages, have been lacking. To obtain such definite information a study of combustion in the space beyond the fuel bed was undertaken, and the results of extensive tests are given in this bulletin. About 100 elaborate tests were conducted in a special furnace using three kinds of coal—Pocahontas, Pittsburgh and Illinois—and at rates of combustion covering the full range found in practice. These are believed to be the most extensive tests of the kind ever undertaken. While the bulletin is especially for those interested in the design or reconstruction of fuel-burning furnaces, it contains much of interest to the general engineer interested in fuel problems. Some of the statements sure to arrest the attention of the interested engineer are as follows: The size of the combustion space required appears to be directly proportional to the percentage of oxygen in the moisture-free and ash-free coal. The percentage of excess air that gives the best results varies with the size of the furnace and the kind of fuel. This fact explains why in one plant the highest efficiency may be obtained with 14 per cent of CO_2 in the gases and in another plant with only 10 per cent of CO_2. There is a definite relation for each coal between the excess air supply and the percentage of CO_2 in the furnace gases. Soot is formed at the surface of the fuel bed by heating the hydrocarbons in absence of air. It is not formed by the hydrocarbon gases striking the cooling surfaces of the boiler. As a matter of fact only a very small trace of the hydrocarbon gases ever reaches the surface of the boiler. Hydrocarbons that do so are prevented from decomposition by the cooling effect of the contact. The cooling surfaces do not cause the formation of soot; they merely collect soot and prevent its combustion. It seems that most mechanical stokers are smokeless

not because they burn the smoke, but because they burn the coal in such a way that very little soot or smoke is produced. Hand-fired furnaces are smoky because soot is produced in or near the fuel bed and cannot be burned in the limited combustion space of the furnace.—*Bulletin* 135, Bureau of Mines.

Traction

Connecticut Company's Power-Saving Campaign.—WILLIAM ARTHUR.—Systematic educational work has reduced the energy consumption per car-mile by 11 per cent in five months. The general details of the plans are given.—*Electric Railway Journal,* March 2, 1918.

Six-Motor Multiple-Unit Trains for Montreal.—KEITH MCLEOD.—Details of a system of two-car semi-trail operation on grades up to 13 per cent. Among interesting features that are pointed out are the multiple-unit control with hand and automatic acceleration, semi-automatic brake system, emergency opening coupler and air-operated doors with safety interlocking control.—*Electric Railway Journal,* March 2, 1918.

Voltage Regulator and Phase-Balancer Regulator Equipment of Philadelphia Electric Company.—R. M. CAROTHERS.—The equipment described in this article was installed to distribute a heavy single-phase railway load over the three phases of the generators. The boosters with their independent exciters maintain constant voltage on the phase from which the railway load is taken, and a shunt phase converter distributes the load to the other two phases and maintains the voltages of these phases equal to that of the first. The single-phase railway load at times reaches the value of 24,000 kva., and the manner in which this load is smoothed out is shown by a chart from a recording voltmeter. Records from the indicating wattmeters and ammeters also show how satisfactorily the phase converter adjusts the load between the three phases.—*General Electric Review,* March, 1918.

Installations, Systems and Appliances

Voltage Regulation of Three-Phase Feeders by Automatically Controlled Induction Regulators.—M. UNGER.—This article treats of the voltage regulation of a three-phase feeder by one three-phase automatic induction regulator and by two or three single-phase automatic induction regulators. Three means are thoroughly discussed and the conclusion is drawn that two single-phase regulators will maintain a better regulation on a three-phase three-wire feeder, carrying mixed power and lighting load, than will a three-phase regulator. The cost, losses and efficiency of either method of regulation will be practically the same. In case it is desired to obtain the best possible regulation on all of the three phases a third single-phase regulator should be added.—*General Electric Review,* March, 1918.

Selection of Steel-Mill Auxiliary Motors.—J. D. WRIGHT.—The functions, mechanical layout and operation of blooming-mill manipulators are discussed. Conclusions are reached as to the size and type of motors as well as the type of control best suited for driving these auxiliaries.—*Proceedings A. I. E. E.,* March, 1918.

Economic Industrial Applications of Electricity.—NORMAN T. WILCOX.—Among the subjects discussed by the author in this paper are the following: Economic uses of electric service, industrial and domestic service, economy of isolated plants, the electric vehicle, refrigeration, electrochemical applications, electric steel furnaces (basic and acid process) and furnaces for non-ferrous metals.—*Journal of the Western Society of Engineers,* October, 1917.

Wires, Wiring and Conduits

Current Capacity of Copper Busbars.—F. M. BILLHIMER.—Considering direct-current conductors, the author says that since the temperature rise of a conductor carrying a direct current depends upon the amount of surface exposed to the air and the resistance of the conductor, it is evident that a conductor large enough in cross-section to carry several thousand amperes with a given rise can be replaced by several small conductors with a total surface greater than that of the large conductor, but with a smaller total cross-section. Problems which are encountered in the application of conductors to direct-current circuits also apply to alternating-current circuits, but in addition to the limits which resistance, shape and spacing place upon the capacity of the direct-current conductor, skin effect and mutual induction must also be considered, as these factors cause non-uniform current distribution in the alternating-current conductor. For laminated-bar conductors arranged with vent ducts and carrying alternating currents the current distribution will, in general, be made as nearly uniform as possible by separating the conductors as far as practicable and making the thickness of the conductor a minimum. For mechanical reasons the thickness of individual bars cannot be reduced too far. In general, no exceptional mechanical difficulties should be encountered in handling currents of 2000 amp. or 3000 amp. For heavier currents careful consideration must be given to the design of both direct-current and alternating-current conductors. Tables and curves are presented giving the effect of spacing on the current-carrying capacity of direct-current copper conductors, variation of temperature with different bar spacings, effect of spacing on current-carrying capacity of conductors, etc.—*Electric Journal,* March, 1918.

Electrophysics and Magnetism

Edge Effect in Copper Bars at Electric Lighting Frequencies.—The results of experiments made to determine the extra resistance due to non-uniform current density in large copper bars carrying alternating currents at 60 and also at 25 cycles per second. Under the conditions which existed in the test, the ratio of the alternating-current resistance to the direct-current resistance is 1.1 to 1.3 at 25 and 60 cycles respectively. These results indicate that the edge effect in large copper bars is of considerable practical importance at ordinary lighting and power frequencies. The ratio of the alternating-current resistance to the direct-current resistance in circular copper bars having the same cross-section as the rectangular bars investigated was less than half that found in the latter. The largest resistance ratio found was 2.2 at 61 cycles in the case of a loop 4.9 m. long with its sides 5.1 cm. apart. Each side of this loop was composed of three copper bars in parallel, clamped in such a way that the individual bars were 6.35 m. apart.—*Journal of the Franklin Institute,* March, 1918.

Electron Discharge Apparatus.—Description of a new form of vacuum tube in which the filament consists in part of thorium, which at a given temperature has a much greater electron emission per unit surface than refractory metals such as tungsten. With this tube substantially the same electron emission per square centimeter has been obtained at a temperature of about 1300 deg. to 1380 deg. K. as with a pure tungsten filament at 2000 deg. K.—*Wireless Age,* January, 1918.

The Electrical Properties of Some High-Resistance Alloys.—M. A. Hunter and F. M. Sebast.—In this article the authors point out that high-resistance alloys must be sought for among those combinations in which metals are in solid solution in one another. An increase in the resistivity of an alloy is usually associated with a decrease in the temperature coefficient, although this is not always so. Ternary alloys have in general a higher resistivity than binary alloys of the same approximate composition. The highest resistivities in the binary alloys were found with nickel-manganese and nickel-chromium alloys. In ternary alloys the highest resistivities were met with ferro-nickel-manganese and ferro-nickel-chromium and copper-nickel-chromium. Chromium alloys withstand oxidation at high temperatures better than the corresponding manganese alloys. Wires of low temperature coefficient were found chiefly among the copper-nickel-manganese alloys. A series of alloys of copper-chromium are indicated which have relatively high conductivities and tensile strengths.—*Rennsselaer Polytechnic Institute, Bulletin No.* 10.

Units, Measurements and Instruments

Characteristics of Current Transformers on Open Circuit.—W. R. Woodward.—By means of vector diagrams the author explains the operation of a current transformer under normal and open-circuit conditions. Curves are given showing typical current-transformer current and voltage waves with the corresponding flux wave and hysteresis loop for high-grade transformer steel. Reference is made to two methods of measuring the peak voltage on open circuit—one by the crest voltmeter and the other a modification of this method. It is pointed out that when the secondary is open the voltage will, in general, be increased with greater area of magnetic circuit, greater number of secondary turns or higher frequency. The converse is also true.—*Electric Journal,* February, 1918.

Telegraphy, Telephony and Signals

Telegraphic and Telephonic Progress in the United States.—A reprint from the *Annales des Postes, Télégraphes et Téléphones* of the general features of the report submitted by the engineers sent by the French government to examine into American methods and progress in the administration of the post office and in telegraphy and telephony. Results achieved in long-distance telephony, in radio-telegraphy and radio-telephony and in the use of multiplex printers in the reception of telegraphic messages are among the things commented on appreciatively by the visitors.—*Revue Générale de l'Electricité,* Feb. 2, 1918.

Telephone Exchange Transfers and Their Organization.—F. G. C. Baldwin.—(Abstract of paper read before the Institution of Electrical Engineers.) After giving three ways of effecting telephonic exchange transfers, the author discusses the relative advantages of each and outlines the problems involved in carrying out the various steps of the transfer. Methods of extracting the heat coils, withdrawing the fiber separators, providing testing and other facilities, changing all of the circuits by making T-connections and handling the exchange organization while the transfer is being made are discussed. The steps which can be taken to secure uniformity of attention to calls, to preclude interruption of service, etc., are outlined.—London *Electrical Review,* Feb. 22, 1918.

Telegraphy Through the Ground.—Charles Nordmann.—A recent order of the German General von Galwitz contained instructions telling how the Germans are using a method of communication known as "telegraphy through the ground." In general, it is a method of communication which is a compromise between wireless telegraphy and one-wire telegraphy. One feature which the new method and the wireless method have in common is that two communicating stations are not connected by wire. They differ in that the wireless sends its waves through the air while the new method transmits them through the ground. These currents are nothing more than induction currents. A wire is placed along the fighting front with both ends extending into the ground, and current is produced in the circuit by some such means as a Rhumkorff coil. Installed similarily at some distance from this wire and parallel to it is another wire in which current is induced by the first, thus permitting the sending of signals from one station to another.—*Le Matin,* Jan. 18, 1918.

Miscellaneous

Horsepower Obtainable from French Rivers.—More than 9,000,000 hp. is obtainable from French rivers for 180 days in the year. Corresponding figures for other European countries show that France is especially favored in this respect, her water-power resources being considerably larger than those of Norway, Sweden or Italy, or, in fact, of any other country, except perhaps Russia, for which no statistics are given. It is also interesting to note that, although the German available water resources amount to only about 1,500,000 hp. per annum, she has utilized 31 per cent of them, whereas only 10 per cent of French water power is yet developed.—*Railway Electrical Engineer,* February, 1918.

Empirical Method for Determining the Ultimate from the Proximate Analysis of Coal.—J. P. Calderwood.—Considered from the chemist's viewpoint, the empirical equations given in this article will not give accurate results, but they are suitable in connection with boiler testing. From an analysis of the possible errors involved, it is interesting to note that the largest error introduced is 1.4 per cent approximately, and that is produced in finding the theoretical air required per pound of coal. Another error which is introduced in calculating the terms of the heat balance amounts to about 8.5 B.t.u. Some relation between the hydrogen volatile matter, fixed carbon and heating value may be developed, the author says, which would add materially to the accuracy of the equations. In deriving the relation between the proximate and ultimate analysis of the coal, a theoretical formula was first established, found from observation or experimental values which contain the coefficients in a literal form.—*Pennsylvania State College Bulletin,* Vol. XI, No. 14, Nov. 15, 1917.

NEWS OF THE INDUSTRY

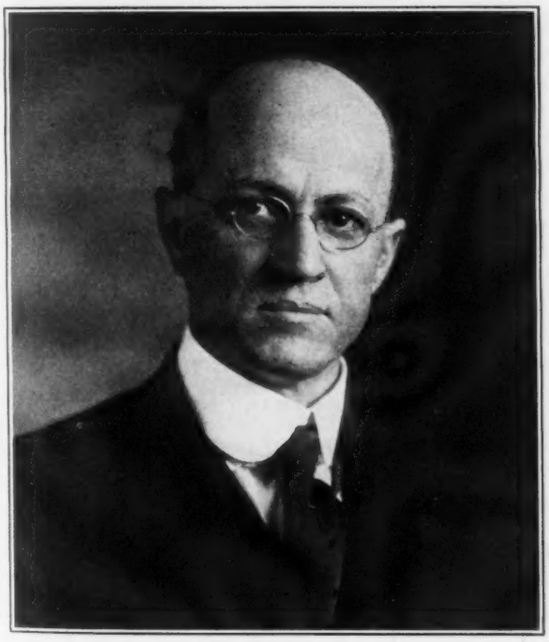
Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

PROF. COMFORT A. ADAMS FOR NEXT A. I. E. E. PRESIDENT

He Is the Nominee of the Directors for Chief Executive of the Institute in the Year Beginning Aug. 1, 1918

Prof. Comfort A. Adams of Harvard University and the Massachusetts Institute of Technology is the nominee of the directors of the American Institute of Electrical Engineers for president for the year beginning Aug. 1, 1918. This is substantially equivalent to his election.

The board has selected from the list of nominees its directors' ticket. Ballots, which will be sent to Institute members the latter part of this month, must be mailed, in order to be voted, to reach the office of the secretary, New York, not later than May 1.



COMFORT A. ADAMS

The list of directors' nominees to be elected at the annual meeting on May 17, 1918, is as follows:

For President—Comfort A. Adams, Cambridge, Mass.
For Vice-Presidents—William B. Jackson, Chicago; Harold Pender, Philadelphia; John B. Taylor, Schenectady; F. B. Jewett, New York; Allen H. Babcock, San Francisco; Raymond S. Kelsch, Montreal.
For Managers—Frank D. Newbury, Pittsburgh; G. Faccioli, Pittsfield, Mass.; Walter I. Slichter, New York.
For Treasurer—George A. Hamilton, Elizabeth, N. J.

Comfort Avery Adams, the newly elected president of the American Institute of Electrical Engineers, was born at Cleveland, Ohio, in 1868. He was educated at the Case School of Applied Science, where he received the B.S. degree in 1890 and the degree of E.E. in 1895.

Professor Adams assisted in physics prior to his graduation; he was engaged in engineering design in 1890 to 1891. In the latter year he became an instructor in engineering at Harvard University, being appointed assistant professor in 1896. Ten years later he became full professor, and since 1914 he has been Abbott and James Lawrence professor of engineering at Harvard and the Massachusetts Institute of Technology.

Professor Adams has been actively engaged in consulting engineering for the past sixteen years, among his clients being Stone & Webster, Boston; American Tool & Machine Company, Boston; Warner Sugar Refining Company, New York; Simplex Wire & Cable Company, Cambridge, Mass.; the Okonite Company, New York, and the Boston Edison company. He was a member of the international jury of awards (department of electricity) at the Louisiana Purchase Exposition, St. Louis, Mo., in 1904.

Besides being a member of the Engineers' Club of New York and other organizations of non-technical character, Professor Adams is a fellow of the American Academy of Arts and Sciences and of the American Institute of Electrical Engineers, having been chairman of the Boston branch in 1905 and 1906, and is secretary of the standards committee of the American Association for the Advancement of Science. Professor Adams also is a member of the Institution of Electrical Engineers, London; of the Illuminating Engineering Society, Society for the Promotion of Engineering Education, American Physical Society and National Electric Light Association.

He has contributed many scientific papers to the technical press and is the author of "Dynamo Design Schedules."

Professor Adams has a host of friends in the electrical profession, who have been drawn by his sterling worth as a man no less than by his scientific and engineering attainments. He has never lost touch with the practice of his profession, although much of his work has lain in the fields of theory and investigation, and his interest in so-called "practical" affairs has led him to contribute many valuable discussions to engineering society meetings.

National Contractors Now in New York

The National Association of Electrical Contractors and Dealers announces that since March 20, 1918, the organization headquarters have been at Room 1703, 110 West Fortieth Street, New York City.

This change, it is agreed, is to the best interests of the association and the industry in general, says Harry C. Brown, the secretary, in announcing the opening of the new headquarters.

Hearings on Administration Water-Power Bill

Congressional Committee in Receptive Mood, and the General Atmosphere Appears Favorable for Legislation Permitting Development Under Conditions Attractive to Private Capital

HEARINGS on the so-called "administration" water-power bill were held in Washington this week before the joint power committee of the House of Representatives which was recently created to pilot the measure through the House. The atmosphere which permeated the committee room was unlike that at other water-power hearings, and there were unmistakable signs that the committee appreciates the necessity of water-power development and is anxious to ascertain under just what conditions private capital can be induced to accept the financial burdens incident to such development.

While every effort is being made to safeguard the interests of the government and of the consuming public, the disposition is to be as liberal as possible in other details so that no injustice shall be done.

Government officials themselves have experienced a change of heart, and there has been no bitter attack on the "water-power trust" or grasping monopolies. In fact, some of the Congressmen have been at pains to draw out from witnesses whether there was such a thing as a "water-power trust" and seemingly were convinced from the answers that no such trust exists or has existed.

Now and then the chairman of the committee, Congressman Sims of Tennessee, put leading questions which might cause one to suspect that the government itself might engage in hydroelectric development if permitted to do so under the Constitution.

None of the witnesses who appeared up to Thursday morning had any serious objections to make to the measure as a whole, which they considered to be the best of its kind thus far offered, and the amendments and changes which they suggested had in view the elucidation of some of the minor features or a change to make the bill more attractive to private capital.

The position of the government with reference to the bill and to water-power development in general was outlined by O. C. Merrill of the Forestry Service, who appeared before the committee on Monday and Tuesday. H. J. Pierce of Seattle, Wash., Calvert Townley of the Westinghouse Electric & Manufacturing Company, New York, and E. K. Hall, vice-president of the Electric Bond & Share Company, were heard on Tuesday afternoon, and John A. Britton, vice-president and general manager of the Pacific Gas & Electric Company of San Francisco, took up all of Wednesday morning and a part of the afternoon discussing California conditions. H. T. Freeman of the Connecticut River Company of Hartford and H. J. Harris of the Big Horn Canyon Irrigation & Power Company of Hardin, Mont., were also heard on Wednesday afternoon, Mr. Harris resuming his testimony on Thursday morning.

POSITION OF THE GOVERNMENT

Speaking as the representative of the Secretary of War, the Secretary of Agriculture and the Secretary of the Interior, Mr. Merrill said:

"The shortage of fuel, the overloading of our transportation systems, the demands for industrial power and the unsatisfactory financial situation of our public utilities emphasize as never before the imperative need of immediate, adequate and comprehensive legislation. Our industrial efficiency, both during the war and thereafter, will be increased or diminished according to whether we do or do not make adequate provision for the development of our water-power resources. In view of these circumstances, it is submitted that water-power legislation should be considered a war emergency measure and as such should be taken up by Congress and passed at an early date."

As the background for this statement Mr. Merrill showed the rising cost of all structural material and how power-plant equipment likewise has gone soaring. Hydraulic machinery has advanced, he said, from 100 to 150 per cent over 1914 prices; electrical apparatus from 125 to 150 per cent; steam turbines, 150 per cent; water-tube boilers, 170 per cent, in addition to uncertainties in delivery. He showed the increasing scarcity of coal, fuel oil and labor and their consequent higher cost and what effect these have had and will have on power production, especially on the Pacific Coast.

These increased costs have resulted in increased cost of steam-power production and have made water-power development increasingly attractive. In fact, they have placed a considerable premium on water power, the utilization of which reduces the use of fuel and the drain on the fuel reserves. Water-power development is therefore a measure of economy as well as a measure of conservation.

INCREASING DEMAND FOR POWER

Notwithstanding increased costs of construction and of operation, the demand for power has increased not at a uniform but at an accelerating rate until during the past two years the annual increment in power generated by central stations alone has been from three to four billion kilowatt-hours, requiring an annual increase in installation of from one and a half to two million horsepower. From the close of 1914 great expansion has taken place, and in 1917 the output of 64 per cent of the industry was 61 per cent in excess of the output of 1914, which in turn was greater than that of any preceding year. Output figures for 1914, 1915, 1916 and 1917, computed from data published in the ELECTRICAL WORLD, were offered by Mr. Merrill.

It was Mr. Merrill's firm belief that the demand for power will continue to increase while war continues, in order to supply power to constantly expanding war industries, and when the war is over to provide for the extension of public utilities and of the electrochemical industries, for elctrification of railroads, and for a multitude of other activities that will accompany the period of reconstruction. As for financing of public utilities, Mr. Merrill said, "The power industry must continue to expand or war preparations will be halted."

RELATION OF LEGISLATION TO EXISTING DEVELOPMENT

The situation, according to Mr. Merrill, shows the need of immediate action on the present measure. He said:

"Even if new water-power developments for the period of the war may be few or none, extension will be required to existing plants in order to meet constantly increasing power demands. If satisfactory legislation is passed, such extensions will be made, particularly in those sections of the country where the rising cost of fuel has become a serious factor in steam-plant operation. But even if new water-power developments could not be undertaken and extensions to existing developments could not be made, legislation will still be necessary in order to give such security to existing developments, hitherto made under unsatisfactory laws, that they may be able to meet their maturing obligations.

"Under the existing financial conditions, uncertainty of tenure places a serious handicap on corporations, making the refunding of obligations unduly expensive if not altogether impossible. Legislation which will permit of the financing of water-power developments upon favorable terms and legislation such as is contained in the 'War Finance Corporation' bill are imperatively needed if our public utilities in general and our water powers in particular are to be able to satisfy the unprecedented demands placed upon them and at the same time to meet their financial obligations.

"While it is essential that water-power legislation should protect fully the public interests in our national resources, it is equally essential that adequate protection should be given to the private capital by means of which such resources are developed. It is believed that the bill before you meets both requirements and that under its provisions capital can be secured and development will take place."

EXTENDING NAVIGATION ON THE COLUMBIA RIVER

Henry J. Pierce of the Washington Irrigation & Development Company told of the possibilities of the Columbia River at Priest Rapids in the central part of Washington. There, by means of a dam at the foot of the rapids and the expenditure of $25,000,000, the river would be made navigable for a further distance of 200 miles; 250,000 hp. could be developed continuously and an additional 250,000 hp. during flood water, or a period of six months. In addition 500,000 acres of desert land would be brought under cultivation. He asked that a holder of a priority permit be protected in all expenditures made in good faith in the development of water power and that he be given the preference for a permit as against others who have not expended time or money. He also asked that any tax imposed should be on the actual power developed, and that in case the license is to be renewed the original licensee have the first right.

Mr. Townley's testimony did not differ essentially from his brief before the United States Chamber of Commerce, which was outlined in the ELECTRICAL WORLD of Jan. 26, 1918. His contention was that, no matter how favorable the legislation, no very great amount of hydroelectric development would be undertaken because of the competition with steam-turbine equipment and the cheapness with which a steam station could be built.

THE VIEWPOINT OF THE INVESTMENT BANKER

E. K. Hall of the Electric Bond & Share Company made an excellent presentation of the water-power situation from the viewpoint of the investment banker. He assumed that Congress would cast every safeguard about the water-power resources for the protection of the public. Having done that and provided for the recapture of the property at the end of fifty years as well as for the regulation of the rates and service by public service commissions, it should make it as attractive as possible to get the water powers developed.

He found two fundamental defects in the bill and suggested remedies for these. No other commercial enterprise, he maintained, called for so large an investment for the profit derived as did a water-power station. In commercial circles the usual turnover is four times a year, while in hydroelectric work the turnover is only once in seven years. Moreover, the amount of investment required is very large in proportion to the amount of the business done. The investment must therefore be protected and made as safe as possible, otherwise money would not be forthcoming. A hydroelectric station differs from a steam station in that if it is a failure it is good for nothing else, whereas a steam plant can be utilized for some other purpose.

He cited by contrast the case of investments in land, where the owner holds title forever, as compared with a heavy investment in a hydroelectric property, where the lease is short, fifty years, with no surety as to what will happen to the title after that except that the property may be taken over by the government for the net investment, or passed to some other lessee or to the original lessee for no specified time. He asked that in the latter case the bill be amended to give a new lease to the development for at least thirty years.

People who invest in bonds, he said, cannot afford to take chances on the principal. They are satisfied to take a smaller return in order to secure safety, therefore the bond should not carry any greater hazard than that inherent to the business. There should be nothing in the legislation that should lead to uncertainty. After the end of the fifty-year period the investor should be assured of a fair deal. The term "just compensation" in the recapture clause would carry conviction and be acceptable to investors. If possible, enterprise and efficiency on the part of the licensee should also be rewarded.

CONDITIONS ON THE PACIFIC COAST

Mr. Britton traced the history of hydroelectric developments on the Pacific Coast and showed to what extent the State of California was indebted to the public utility companies for its upbuilding. As indicative of the unsatisfactoriness of existing regulation relative to development on the public domain, he cited the case of one of his company's projects having a potential possibility of 200,000 hp., which has been built, so far as its reservoirs, canals, flumes, forebays, pipe lines and power houses are concerned, entirely upon land, aggregating 12,578 acres (more than 5000 hectares), owned in fee by the power company, with the single exception of 38.7 acres (15.65 hectares) of land overflowed by one of the reservoirs. These 38 acres have been placed in the forest reservation. It is land barren and bare of any vegetation, granite rocks rising above other granite rocks, upon which vegetation would be im-

possible, and yet because the flooding of this meager acreage by the backfilling of the water from the dam impinges upon the alleged forest reserve, the government demands that all parts of the project shall come under its control and domination and be subject to the provisions and permits heretofore quoted.

In another instance his company has a power project having a potential possibility of 250,000 hp., said Mr. Britton, in which less than 2 per cent of the entire land devoted to the project is upon government reservation. The project could be developed (but the power would be lessened some 10 per cent) by moving down the stream a few feet, and the project would then be entirely without the forest reservation. Patriotic duty would seem to impose upon the promoters of this project the utilization of the water to the fullest extent possible, yet these conditions of patriotic submission would result in cost charges and obligations that would render it impossible to finance the project under the conditions imposed by present rules and regulations.

Mr. Britton said that the demands made upon the power companies for quick developments, owing to the building up of the population of California by the creation of industries and by the reclamation of other lands, taxed the resources of the power companies to such an extent that they could not, either financially or physically, keep pace with the demand, because of the restrictive conditions recited. Steam plants, therefore, because of less first cost, were erected as auxiliaries to water-power plants, and cheap oil in the earlier days of power demands made it possible to install steam plants near the center of load and to carry the peak load economically, and by tying in with the hydroelectric system to insure continuity of service economically. The low price of unit installation of steam plants, as against the much greater price of hydroelectric, also made such a condition possible. Because of shortage of rainfall last winter the Pacific Gas & Electric Company, with the consent of the Fuel Administration, is installing a 20,000-kw. steam-turbine unit so as to insure service to war industries this fall.

The necessities for hydroelectric development in California, if propounded in the form of an inquiry, could best be answered by the statement that there is an extreme necessity for the conservation of that which is limited and exhaustible and has certain superior uses, as has oil, and the providing of a substitute therefor which is perennial and inexhaustible, such as water.

The dependency of the State upon a water supply sufficient to operate its hydroelectric plants during the ordinarily dry season has been upon the stored water, not in reservoirs alone but as well in the frozen packed snow in the high ridges of the mountains that flank its eastern border. This frozen and packed snow slowly melts during the spring months, and the run-off is ordinarily amply sufficient to prevent draft on the reservoir storage until the months of June or July.

In the absence of this frozen snow and in the absence of additional reservoir capacity in the mountain regions, the supply of energy must be made up by steam plants. This situation now confronts California, the available storage being good for but forty-five days of demand, and it follows that steam must be resorted to for the other forty-five days of normal dry season to carry the load on the combined systems.

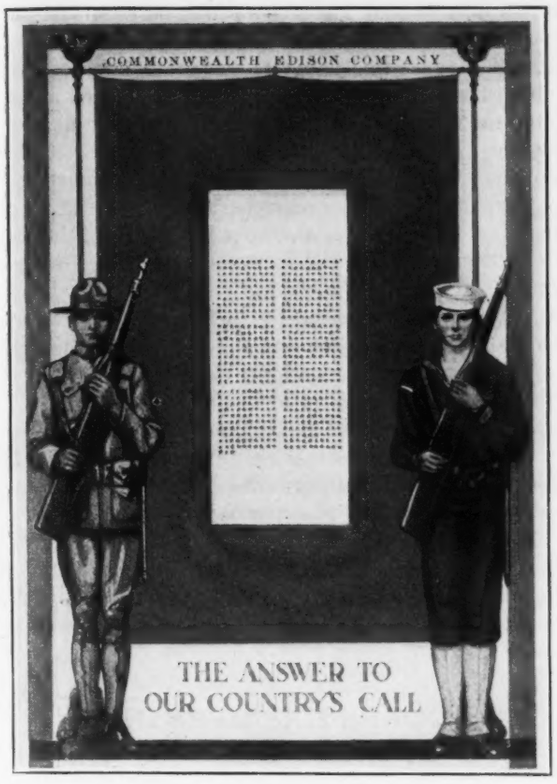
Encouragement of power projects by the government must be made by liberal terms, in order to insure the building of additional reservoir capacity to tide over abnormal years, such as this, and to minimize as much as possible the necessity for steam plants.

ANNUAL MEETING OF THE ASSOCIATED MANUFACTURERS

Large Advance Registration for Gathering on March 21 Indicated Successful Convention of Manufacturers in New York

A large advance registration indicated that the annual meeting of the Associated Manufacturers of Electrical Supplies at Delmonico's, New York, on March 21 would be attended by a great number of representatives of the companies.

The program, as outlined generally in previous issues of the ELECTRICAL WORLD, provided for a business session at 2 p. m. and a banquet at 7.30 p. m.



The Commonwealth Edison Company, Chicago, inserted in copies of its annual report to stockholders a reproduction of the company service flag, thus calling attention to the war activities of the many employees who are at the front.

LARGE BUSINESS OF THE WESTERN ELECTRIC COMPANY

Total Sales of More than $150,000,000—Engineering Department Renders Important Service to the Nation in the War

Sales of the Western Electric Company, Inc., in 1917 were $150,340,000, an increase of 40.5 per cent over 1916. This large total puts in concrete form the statement of President H. B. Thayer that "the business of the company has been larger than in any previous year. This is true of both the sale of its own manufactures and the sale of merchandise not made by it."

For 1916 the sales were $106,987,000, and for 1915 they were $63,852,000. The orders on hand Dec. 31, 1917, were $1,950,000 in value less than on Dec. 31, 1916. The average value of an order filled during 1917 was $107, as compared with $75 for 1916.

Mr. Thayer says in the report to shareholders:

In our own manufactures the demands from regular customers (the Bell Telephone companies) were very heavy at the beginning of the year, but as the demands for equipment to meet emergency requirements directly or indirectly caused by the war have increased the ordinary requirements have decreased so that to a large extent a more expensive and less profitable business kept us busy during the latter part of the year. Therefore, while the profits in this class of business have been larger than in 1916, they have not, as compared with earlier years, been in proportion to the increased investment in the business. On sales of merchandise not made by us the profits have been very satisfactory.

There is no return from foreign investments included in the profits of the company for 1917. As to some information is entirely lacking, and as to others it is incomplete. It is our belief, however, that as a whole a conservative valuation of them would require no addition to reserves, the earnings of some of them being apparently sufficient to offset the possible losses of others.

On the entry of this nation into the war we practically placed our engineering department at the service of the nation and believe that it has rendered important service. This has involved large expense and indirect loss through the interruption of our regular engineering program, but because we believed that we were able to render great service we believed also that the responsibility upon us to render it was great and that our stockholders would approve of our action. On such orders as we undertake for the military departments we have agreed to a basis of cost plus a very moderate profit.

The difference between present cost and cost on the basis of prices before the war on buildings and equipment added to the plant during the year has been credited to reserve for depreciation on plant.

It has seemed wise on account of the large merchandise investment and the prevailing high costs to set aside to the reserve for contingencies $2,000,000 and on account of the large increase in the number of employees since the establishment of the employees' benefit fund there has been added to that fund the sum of $500,000.

Our shop force increased during the year from 18,928 to 21,549 employees. The total number of employees at Dec. 31, 1917, was 30,737.

The total disbursements from the employees' benefit fund for 1917 amounted to $173,915. These payments covered all classes of benefits and were made to 2894 beneficiaries.

Earnings for the year ended Dec. 31, 1917, follow:

Sales		$150,340,359
Other income		1,309,192
		$151,649,551
Cost of merchandise	$135,427,053	
Expenses	8,487,527	
Taxes	1,073,411	
Appropriated for:		
Reserve for employees' benefit fund	500,000	
Reserve for contingencies	2,000,000	147,487,991
Available for interest and dividends		$4,161,560
Interest paid	$1,309,844	
Dividends	2,550,000	
Carried to common stock	301,716	$4,161,560

Real estate and buildings stand in the balance sheet at $12,911,537 and machinery and equipment at $12,134,759, a total of $25,046,296. Total current assets of $74,527,538 are divided as follows: Merchandise, $44,415,028; cash, $4,257,150; bills receivable, $1,177,166, and accounts receivable, $24,678,194. Sundry investments are $13,094,686.

The 300,000 shares of preferred stock are listed at par, $30,000,000. The common stock, 150,000 shares of no par value, is carried at $25,755,364. There is also $15,000,000 bonded debt, making total capital liabilities of $70,755,364. Bills payable aggregate $10,600,000 and accounts payable $9,194,558. There are reserves of $16,285,136 for depreciation on plant, of $1,500,000 for employees' benefit fund and of $4,333,462 for contingencies.

PACIFIC COAST SECTION OF N. E. L. A. POSTPONES MEETING

Convention Scheduled to Be Held at Del Monte on April 24 to 27 Is Postponed Indefinitely to Avoid Interference with Liberty Loan

Definite arrangements had been made by the Pacific Coast Section of the National Electric Light Association to hold a convention at Del Monte, Cal., on April 24 to 27, but to avoid interference with the campaign for the third Liberty loan it has been decided to postpone the meeting indefinitely.

ELECTRIC HOIST MAKERS FORM NEW ASSOCIATION

Services of Member Companies of Electric Hoist Manufacturers' Association Are Offered to Government to Facilitate War Service Work

The Electric Hoist Manufacturers' Association, by a resolution adopted at its last meeting, has offered the services of member companies to the government in meeting the extraordinary demand for their product.

The War Industries Board of the government has requested full information concerning the ability of the electric hoist manufacturers to handle the volume of business offered them, as well as regarding the effect of priority orders and embargoes on shipments upon the trade.

It is evident that the association will be of great assistance to the War Industries Board, as it is becoming more apparent from day to day that there are numerous advantages for all concerned in having manufacturers in certain lines organized. This is especially so now in the hour of national crisis. Instead of vindictive competition and antagonism along business lines the association brings the spirit of co-operation and exchange of ideas, looking toward increased output.

Electric hoists for shop use and handling material have gone through various stages of development during the last fifteen years and, like all other classes of shop machines, they cannot be successfully designed on the basis of theory alone. Actual experience in meeting hoist requirements and innumerable corrections and refinements in design on the part of the manufacturers have marked the progress of these last fifteen years in this important field.

The many mistakes on the part of both manufacturer and user during this development period have created in some instances a lack of confidence in electric hoists as a class. On the other hand, many users have been led to believe that such hoists are unaffected by abuse and can consistently be called "fool-proof."

Some discredit to these machines has developed on account of lack of standardization in nomenclature, service rating and general characteristics on the part of the makers.

Now that it is thought that the experimental stage has well passed and acceptable designs have been developed by various manufacturers, it appeared wise to co-ordinate the total experience and to make available for the user all that is best in electric hoist design and practice. With this object in view the manufacturers of the United States organized the Electric Hoist Manufacturers' Association, comprising the following companies: The Brown Hoisting Machinery Company, Detroit Hoist & Machine Company, Euclid Crane & Hoist Company, Franklin-Moore Company, Link-Belt Company, Roeper Crane & Hoist Works, Shepard Electric Crane & Hoist Company, Sprague Electric Works and Yale & Towne Manufacturing Company.

The officers of the association are as follows: F. A. Hatch, chairman, Shepard Electric Crane & Hoist Company; F. W. Hall, vice-chairman, Sprague Electric Works; C. W. Beaver, secretary-treasurer, Yale & Towne Manufacturing Company.

The association holds monthly meetings for the purpose of studying the specific needs of the hoist user and to develop standardized methods of presenting information to him so that guess work will be eliminated. The association will consider uniform nomenclature pertaining to types and parts of electric hoists, fix upon a standard by which hoist motors shall be rated and promote the standardization of electric hoists as far as possible. It will also collect and disseminate information and statistics relative to the electric hoist industry, provide facilities and opportunities for study and education in regard to the economics of the industry, extend the use of the product by pointing out the great number of material-handling problems of different classes that can be solved by the use of electric hoists, promote friendly intercourse and co-operation among the members and disseminate information that long experience has taught is essential to any hoist to insure good results, and recommend to the members of the association well-established principles as to both construction and equipment that will tend to eliminate any possibility of inferior equipment.

The membership of the association is confined to those engaged in the manufacture of monorail electric hoists, which have revolutionized the handling and transportation of material in and about industrial plants.

SIGNAL CORPS HAS OPENING FOR MANY ELECTRICAL MEN

They Are Required for Various Branches of Important Army Radio-Communication Work of Several Classes

The Signal Corps, United States Army, has announced that it can use the services of a large number of men having electrical training. They are needed especially in connection with the radio-communication systems in use in the military service. All classes of electrical men—wiremen, expert electricians, storage-battery men, telegraph and wireless operators and men with electrical engineering training and experience—are wanted. The opportunity offered is unusual because of the great interest and importance of this branch of the service, which has been most aptly characterized as the nerve system of the army. Men engaged in the radio division of the communication work in particular have an increasingly important part in the great intelligence system upon which army operations are almost totally dependent.

The scope of this work requires men who will fall in general into three classes, depending on the character and amount of experience had by the individual; namely, radio operators, radio mechanics and field radio experts.

Application blanks for service in the radio work of the Signal Corps may be secured by addressing the office of the Chief Signal Officer, Land Division, Training Section, Washington, D. C. Men of draft age may make application and if qualified will be inducted into the army, at their request, for service in this branch of the Signal Corps.

After enlistment or induction, all personnel will be sent to one of several radio schools for six weeks to three months of intensive training in that one of the three general branches of the radio work for which their previous experience qualifies them. Some of the personnel completing these courses will be commissioned, advancement depending on individual ability.

DUTY OF THE COMMISSIONS IS CLEAR

BY MAX THELEN

President California Railroad Commission

In the situation which now confronts many of our public utilities the duty of the State commissions is clear. While providing for the continuation of adequate service, it is their duty to act promptly and vigorously on applications for increased rates based on increased operating costs.

Where the usual methods of rate making would result in unreasonable delays, short cuts must be applied to meet the emergency conditions.

Our public utilities must be kept in a sound and healthy financial condition, so that they will be able to meet not merely the requirements of their existing patrons but also the additional requirements of the war.

The State commissions should not wait until the utilities come to them with their pleas for assistance. It is their duty to inform themselves by their own investigations, if necessary, concerning the condition of the public utilities under their jurisdiction and to keep themselves constantly informed.

If the State commissions rise to meet the situation, as they are doing in all sections of the country, they will be rendering a substantial service not merely to the utilities and their patrons but also to the nation itself, which is largely dependent for war efficiency on the service of public utilities.

WAR-TIME PROBLEMS OF THE UTILITIES IN CALIFORNIA

President Thelen of the State Commission Shows How That Body Looks Upon the Conditions Created by the War

Max Thelen, president Railroad Commission of California, gave a lecture in the University of California extension public utility regulation course on March 6, at the Fairmont Hotel, San Francisco. His subject was "War-Time Public Utility Problems." President Thelen dealt with such utilities as street railroads, gas companies, electric companies and water corporations. He spoke of rates, services, extensions, and particularly finances. He set forth the problems and what is being done toward their solution. This lecture was open and free to the public.

Mr. Thelen divided his problems into four headings—rate, service, extension and financial problems. On rates he showed the difficulties of utilities in confronting the increased cost of operation, due to higher cost of fuel, materials and labor, the price of almost all materials having practically doubled. He said in part:

In California 106 formal applications have been made to the commission for authority to increase rates between April 6, 1917, the day on which war was declared to exist, and March 1 last, by such utilities as water, gas, warehouse, steamship, electric, railroad, telephone, jitney and express companies. These applications have ranged from requests for slight increases in small communities to applications of widespread interest and importance affecting all or large portions of the State, such as the applications of the Pacific Gas & Electric Company and the Great Western Power Company for authority to increase electric rates in the entire territory served by them in the central and northern sections of the State.

Forty-seven applications have been granted, sixteen have been denied or dismissed and forty-three are now pending. The commission realizes that the public utilities are suffering. Where an emergency exists and where the usual method of handling rate applications, including a valuation of the property and an audit of the books, fails to meet the situation, the commission does not hesitate to apply emergency measures. We fully agree with President Wilson's letter to Secretary of the Treasury McAdoo that it is essential that these utilities be maintained at their maximum efficiency during the war, and that everything reasonably possible should be done to accomplish this end, and we act on that view. Public utilities should not expect to increase their profits during the war.

When a street railroad or other public utility comes before a State commission and asks for increases, it should come prepared to show that it has eliminated all unnecessary expense and has introduced all economies of operation compatible with the continuation of reasonably good service to its patrons.

Electric companies and their patrons in various sections of the country have already felt the effect of the so-called "lightless nights." These and other service problems must be solved, not on the basis of pre-war conditions, but from the point of view primarily of assisting to meet the nation's war requirements.

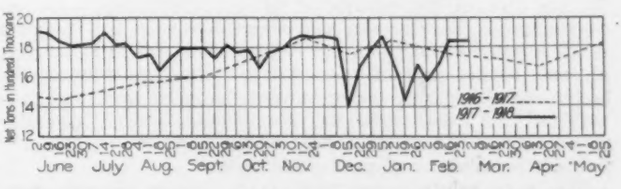
The necessity of conserving man power, materials and money necessarily has an important influence on the extensions of public utility systems during the war. Capital expenditures which before the war would have been entirely justified from the point of view of a particular utility and its patrons may now be inadvisable and undesirable because the utility may be able to get along for awhile without them, or because they do not harmonize with the unified operation of the particular utility concerned and other like public utility systems, all laying aside their purely competitive activities during the war. On the other hand, the requirements for additional light, heat, power and transportation by industries engaged in the production of necessary materials, supplies and food are such as to require imperatively all over the United States additions and extensions to the existing production and distributing systems of public utilities to meet the added requirements. It is essential that the financial strength and stability of these utilities be conserved by deferring capital expenditures not directly needed for war purposes, and that the funds thus conserved and such other funds as may be necessary be used for such additions and betterments as will assist most effectively to meet the nation's war requirements.

Soon after the outbreak of the war it became almost impossible for public utilities to secure large amounts of additional funds by the sale of securities in New York, Chicago and other financial centers of the country, with the exception of the sale of short-term notes, well secured and, in a few cases, of gilt-edge bonds at 6 per cent. The requirements of these utilities must be met.

Thus, in California, the commission during the eleven months beginning April 6 last authorized the issue by public utilities of $72,828,150 stocks or bonds, as contrasted with $99,625,000 during the twelve months ended June 30, 1917, and $231,644,870 during the twelve months ended June 30, 1916.

The government has taken steps to provide that large issues of securities of public utilities and other concerns, both public and private, shall not be sold during the war in competition with government issues, and in no event unless really essential to the interests of the nation at this time.

Coal Production Better



Bituminous coal production, as reported by the United States Geological Survey, is now running ahead of last year's output.

HEAVY COSTS FOR POWER PRODUCTION

W. C. Slade, Telling Experiences of Rhode Island Company, Shows Great Need of Considering Boiler-Room Expense and Practices

Walter C. Slade, superintendent of power and lines of the Rhode Island Company, Providence, addressed the New England Street Railway Club at Boston recently on the difficulties and trials of producing steam-generated energy in war times.

"The question of the cost of production, although always of prime importance," said Mr. Slade, "has at times been obscured at least temporarily by the more important question whether for certain periods power could be produced at all, irrespective of the cost. In Rhode Island we have felt the shortage of bituminous coal keenly. The two power-producing utilities at Providence have been operating of late with inadequate coal reserves, and the Rhode Island Company in particular has recently been forced to operate its main power station for three or four days with borrowed coal entirely." Mr. Slade continued in part:

The prices which we have been forced to pay for coal in cargo lots alongside the Providence plant have varied, but they seem to be constantly increasing. In the spring of 1917 we paid as high as $11 and $12 a ton for some coal and bought considerable coal at prices between $6 and $9 a gross ton. Later developments proved that this action was justified.

The effect of the quality of the coal was reflected directly in the cost of operation, in addition to the effect of the higher cost of the coal alongside. It resulted also in increased boiler-room maintenance. The net result was to raise the unit cost of power for the year 1917 by 104 per cent, as compared with the twelve months ended June 30, 1916.

Between the average large 60-cycle central station and the average large 25-cycle railway station there can be no interchange of power except through frequency changers, a method which is sufficiently uneconomical to make this exchange feasible only for emergency purposes. Such an arrangement for emergency operation is, however, feasible.

It is also equally practicable in certain cases, it would seem, when new equipment is added to existing 25-cycle power plants, to install the equipment for 60-cycle operation, so that in the future more railway plants would be able to take advantage of central-station power, which in normal times is steadily being produced at decreasing cost, as well as of hydroelectric 60-cycle developments that will, doubtless, be made throughout the country.

But what of the small engine-driven railway plant that is struggling along trying to produce power cheaply even in normal times? Many of these plants could and should be shut down as soon as arrangements can be made for equipment suitable for operating from central station or hydroelectric service. With increasing cost of coal, the balance is all in favor of the big station, and it is questionable if the price of coal in future years will reach a minimum that is $1 to $1.50 a ton above the prices that prevailed before the war.

As regards increasing economies in our power stations I am going to speak principally of the boiler room. In ordinary times the fuel item will represent from 70 per cent to 75 per cent of the total cost of generated power. I recently stated that our own experience had seen the fuel cost reach a point equal to 83 per cent of the total cost; in fact, at least 90 per cent of the total cost was expended in the boiler room for fuel, water, wages, supplies and materials required for maintenance. We should indeed consider spending money in such a field where such a large proportion of the expense of production lies.

The best solution, perhaps, is to follow the practice, already observed I believe in a few cases, to put under the chief engineer a technically trained man or at least a man who understands the theory of combustion sufficiently well, who can keep constant check of operating conditions in the boiler room, working in constant touch with the chief engineer. This type of man has been termed "combustion engineer."

Working with the assistance of the necessary weighing, measuring and metering devices with which he should be provided, he could put the true spirit of industrial control into boiler-room practice. To aid the "combustion engineer," so called, in effecting the desired economies, it would be well to consider the advisability of making the operation of all equipment as nearly automatic as possible.

WORK ON FUEL ECONOMY BY NEW YORK COMMISSION

Conference in Albany Decides to Appoint Coal-Saving Committee if State Fuel Administrator Approves the Plan

How to effect economy in fuel and power consumption was the subject of a conference held on March 6 in Albany by the New York Public Service Commission, Second District, acting in co-operation with A. H. Wiggin, the New York Fuel Administrator. Chairman Hill of the Public Service Commission presided, and the Empire State Gas & Electric Association, which represents 90 per cent of the output of gas and electric light for commercial and street-lighting purposes, was represented by J. T. Hutchings of Rochester, C. A. Graves, C. H. B. Chapin and Stuart Wilder of New York and H. W. Peck of Schenectady.

The conference decided that, if the State Fuel Administrator approves the plan, a committee will be appointed to consider the possibilities of coal saving. The committee will consist of representatives of the State Fuel Administrator, the New York State Conference of Mayors, the Public Service Commission, Second District; two or three representatives of the gas and electric producers and the New York State Manufacturers' Association.

The plan, as outlined, provides for an educational campaign to effect economy in lighting and cooking and curtailment of non-essentials, including signs; economy in street lighting and in the operation of power plants and through saving of coal by concentration of generation; the utilization of water power through interconnection of systems and the development of unutilized water power.

DAYLIGHT SAVING HOUR WILL BE PUT IN FORCE

Effective from March 31 to Oct. 27, Central-Station Industry Is Studying the Possible Effect on Revenue and Output

President Wilson signed without ceremony the daylight saving bill on March 19. The effect of it will be that all clocks will be put forward one hour on the last Sunday in March and turned back again on the last Sunday in October. The official change in time will take place at 2 a. m. on the days mentioned.

The daylight-saving law is recognized in the electrical industry as primarily a war measure and is, of course, accepted patriotically as a necessary step in conservation. It is expected that the resulting curtailment in lighting will have some effect on revenues and the operation of the law is awaited with much interest.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Patent Office Improvements.—A composite committee has been created by the National Research Council to make a preliminary study of the problems of the United States Patent Office and its service to science and the useful arts. This committee comprises L. H. Baekeland, W. F. Durand, Thomas Ewing, Frederick P. Fish, Robert A. Millikan, E. J. Prindle, Michael I. Pupin and S. W. Stratton. All interested in making any patent-reform suggestions are advised to forward them at once to Dr. W. F. Durand, National Research Council, Washington, D. C. The particular point upon which suggestions are desired is the manner in which greater efficiency and work of higher quality can be secured in the Patent Office.

Financial Extensions in War Time.—The Mount Whitney Power & Electric Company, Visalia, Cal., has filed with the California Railroad Commission an application for approval of a plan for financing the construction of necessary extensions to its system during the war. The company distributes electric energy in Tulare, Kern and Kings Counties and has estimated that it will have to expend during 1918 $108,561 upon its system, besides $216,936 for extensions. It will have available for the latter purpose only $60,000 and has therefore devised a plan under the terms of which those making application for power will be required to advance to the company part of the cost of building the necessary lines. The plan further provides that ordinarily the company will not accept applications for power where they do not yield an income the first year equal to 20 per cent of the total cost of installation.

Rate Increase Sought in California.—The San Joaquin Light & Power Corporation has filed with the California Railroad Commission an application for authority to increase electric rates in Mariposa, Madera, Merced, Fresno, Tulare, Kings and Kern Counties. The application says that heretofore, under normal conditions of rainfall, the company has been able to generate almost all its energy at its hydroelectric plants, but that owing to the failure of rain this year in the San Joaquin valley, the lack of snow in the mountains and the consequent shortage of water for irrigation by gravity flow, even if there should be a normal rainfall for the remainder of the season, the company's hydroelectric plants could generate less than half of the required power for its consumers. It will therefore be necessary to operate steam plants and generate electricity by the use of gas and oil as fuel, adding $600,000 to the company's annual operating expenses, besides increased cost of materials, the larger sum paid in wages and higher taxes.

The Government Rebuffs the Sanitary District.—In one of the various controversies between the federal War Department and the Sanitary District of Chicago a special board appointed by the Secretary of War made the following statement as a part of its report: "To restore the diminished levels in the lakes by constructing contracting works in their outlets does not, however, present any series difficulties. Compensation for the loss of elevation on Lakes Michigan, Huron and Erie and their connecting rivers, due to an assumed diversion from Lake Michigan of 10,000 second-feet, will by the plan above outlined involve an expenditure of $475,000. It is the opinion of the board that, while other plans have been proposed, compensation by fixed contraction works similar in general to those above described affords the cheapest and most satisfactory method of preserving the levels of the Great Lakes." Subsequent to this report the Sanitary District, in order to remove the continuous government objection to the withdrawal of water from Lake Michigan, offered to build and maintain the contracting works. On Feb. 26, 1918, the engineering bureau at Washington, through Chief of Engineers Black, reported adversely on the Sanitary District's proposal, finding that the bill for permitting the construction of the contracting work was in violation of a treaty with Great Britain.

Extension of Activities by Wisconsin Operators.—The Wisconsin Security Company, the main activities of which were formerly the financing and operation of Wisconsin public utilities, has increased its capital stock from $300,000 to $1,300,000 in the last year. During that time the company acquired the entire capital stock of the Manitowoc & Northern Traction Company. It also acquired the Calumet Service Company, furnishing Chilton, Wis., with light and power, as well as control of the Baltimore (Md.) Dry Dock & Shipbuilding Company. The latter is now the largest property controlled by the company. It is said that with its new addition this property represents an actual physical value of more than $7,000,000. On the property of this company eight ships of 8800 tons are now being built for the Emergency Fleet Corporation, according to Clement C. Smith, president of the Wisconsin Security Company. The company is also building ten 6200-ton steel cargo ships under contract for the Cunard Steamship Company, the French Republic and Norwegian and British owners. These have been commandeered by the Emergency Fleet Corporation. The company is building seven ships for the Navy Department. In his report Clement C. Smith said: "This shipbuilding activity is a big feature of our 1918 business. Our Wisconsin enterprises will be held in obeyance until a more favorable time."

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month on the next-to-last text page.

Providence Engineering Society.—"Motor Troubles" were discussed by W. F. Hodges of the J. H. Electric Company before the Providence Engineering Society on March 13.

N. E. L. A., Brooklyn Section.—W. Uckele presented a paper on "Pressure Regulation on Two-Phase, Sixty-Cycle Feeders" before the Brooklyn company section of the N. E. L. A. on Feb. 19.

Engineers' Society of Milwaukee.—Prof. C. M. Jansky, assistant professor of electrical engineering, University of Wisconsin, gave a talk entitled "Science in War" before the Engineers' Society of Milwaukee, March 13, 1918.

A. S. M. E., Philadelphia Section.—A paper on "Recent Developments in Methods of Measurement" was presented by Dr. F. W. Stratton of the United States Bureau of Standards on March 26 before the Philadelphia Section of the American Society of Mechanical Engineers.

Columbus Electrical Contractors' Association.—At the annual meeting of the Columbus (Ohio) Electrical Contractors' Association on March 14 Carl Entrekin was chosen president, William McGaraity vice-president and Charles Weisz secretary-treasurer. The members reported business conditions good.

Engineering Society of Buffalo.—"Hydroelectric Power Problems" was the title of a paper by J. A. Johnson presented before the Engineering Society of Buffalo on March 13, 1918. In this paper the author discussed the general considerations involved in the location of industries for economic reasons.

New York Electrical Society.—"Experiences at the Front in France and Flanders" was the title of a talk at a joint meeting of the Engineers' Club and the New York Electrical Society by Lieut. Pierre Chevalier, Twenty-second French-Canadian Battalion, on March 18, 1918. Dr. Charles A. Eaton, head of the National Service Section of the United States Shipping Board, Emergency Fleet Corporation, also spoke on "The United States as a Test of Democracy."

Spring Meeting of the A. S. M. E.—General war subjects and a discussion of how the engineer can help the government in the war will be the important features of the spring meeting of the American Society of Mechanical Engineers in Worcester, Mass., June 4 to 7. The meeting will open on Wednesday, June 5, which will be New England Day, and the discussion will dwell on the interests of New England in relation to the war. The remainder of the time will be spent in general and technical sessions and inspection trips.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Implied Repeal of City Charter.—A municipal corporation whose charter as amended in 1901 gave it general authority to take water from any brook in a named town instituted condemnation proceedings for the purpose of increasing its water supply by taking the waters from a tributary to a creek in which the defendant corporation proposed to erect a power plant and had erected dams, etc. The respondent corporation, chartered in 1905, was authorized to build dams on the creek and its tributary for the purpose of providing necessary ponds and reservoirs to utilize the power of the stream, and in that connection was granted the powers of individuals to flow lands. The respondent corporation was also authorized to generate electricity and distribute it, and further to construct a railroad, etc. The Supreme Court of Errors held, in East Hartford Fire District versus Glastonbury Power Company (102 A. 592), that, as it only received the flowage rights of individuals, and the flowage act does not authorize the condemnation of land except for raceways, respondent's authority to build dams was necessarily to be exercised on lands acquired by consent of the grantors and lessors, and hence its charter was not an implied repeal of the authority of the municipality to take water to increase its water supply.

Property Devoted to Public Use in Eminent Domain Proceedings.—As virtually all streams available for municipal water supply were at an early date utilized for water power either directly or through their connecting waters, statutes generally authorizing municipal corporations to acquire waters for municipal water supply must be deemed operative upon streams already used for water power, at least when such water power is not already employed in some other public use at the time of the proposed taking, the Supreme Court of Errors of Connecticut held in East Hartford Fire District versus Glastonbury Power Company (102 A. 592). Property already appropriated to one public use cannot thereafter be condemned for an inconsistent public use unless such taking is authorized expressly or by clear implication, and this rule applies to property about to be lawfully appropriated to a public use, though the appropriation is not complete. Where respondent corporation authorized to exercise the flowage rights of individuals and use water of a creek to generate electricity had not commenced the generation and distribution of electricity, although it had acquired rights in the stream for that purpose, such corporation cannot, its property not being devoted or about to be appropriated to a public use, defeat condemnation by municipal corporation which sought to take the waters of a tributary stream to increase its water supply.

Failure to Remedy Defect in Abandoned Charged Line.—A power company that left a branch wire across a pasture connected and charged after abandoning its use had no right to presume that the wire would continue to remain in a proper and reasonably safe condition without being looked after, the Kansas City Court of Appeals held in Kribs versus the Jefferson City Light, Heat & Power Company (199 S. W. 261). Where an unusued branch power line was left highly charged in a place where persons frequently went it was the duty of the power company to see that the line was maintained in a reasonably safe condition, and if it got into a dangerous condition and remained so for such a length of time that the power company in reasonable prudence should have discovered and remedied the defect before an accident, it was negligent. That boys, one of whom was killed when he grasped a guy wire dangling from a charged power wire, were in the pasture without authority from the owners could not excuse the power company from liability for its negligence, persons having frequently passed through the pasture for so many years that it was incumbent on the company to keep its line safe and that it incurred legal liability because of any failure to do so.

Date and Point of Shipment Determine Classification of Goods Shipped.—The Gibbes Machinery Company had a fire in its storehouse in which a lot of gasoline engines were badly damaged. All the small parts of the engines, including trimmings, etc., were either melted or broken off, and for the purpose of having them rebuilt, if it could be done profitably, they were sent to the factory where originally made. The machinery company offered to ship them as scrap iron, but the carrier refused, and they were shipped as "burned engines," and the rate for that class was charged. Upon their examination at the factory it was found that the cost of rebuilding the engines would be more than new engines were worth, and they were therefore sold as scrap iron by direction of the machinery company, whereupon the latter demanded of the carrier the difference between the rate paid and that which would have been paid if the shipment had been classed as scrap iron. The Supreme Court of South Carolina, holding the shipper not entitled to recover (93 S. E. 718), said: "The justice of the case as well as the law is with defendant. Plaintiff had no right to require defendant to assume or bear any part of the expense incident to its experiment. Under the act of Congress, the classification of the shipment was to be determined at date and point of shipment, and charges made and collected according to the schedules and tariffs filed with the commission."

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Property Values Under War Conditions.—The decision of the New York Public Service Commission, First District, reducing electric rates of the Flatbush Gas Company says, in speaking of value: "It is contended by the respondent that it is entitled to a fair return upon the amount of property used by it in the public service, measured by opinion estimates of the reproduction cost thereof, even where data of actual cost are available. The claim that its return should be calculated on estimates of what it ought to cost to reproduce the property is moderated slightly by its obviously proper concession that there should first be deducted from the face of these estimates the amount of the accrued depreciation, figured, not on the reproduction cost new of the property, but upon the much lesser amount of original cost, and also that the unit prices to be assumed or assigned for the reproducing of the property should be taken from or reduced to pre-war and normal market levels. If, however, it is to be recognized that the value of the property upon which the respondent is entitled to earn a return through its rates is to be measured solely by the reproduction cost thereof, unaffected by consideration of the actual outlay therefor by the investors and regardless of the methods and conditions of original construction, then logically there would seem to be no escape from the conclusion that the respondent would be entitled to claim a return upon such a property cost as would be attributable to it if all the property were produced or reproduced in one continuous operation at present-day market prices of labor and materials. In the present juncture of universal upheaval, the application of such a postulate of evaluation to rate making would lead to startling consequences. Without a dollar of additional investment and in the face of adversity and suffering, the value of the respondents' property would be deemed to have vastly increased, and the amount which the company's investors are entitled to take from the consumers would be deemed to have much increased. On restoration of normal conditions investment made in property of the company at war-time market prices will of course shrink in value, perhaps violently, as prices tend to resume normal levels, and even the investments previously made might shrink if there should be a considerable depression in market quotations." The dangers of computing return on estimates of reproduction cost less depreciation were never so obvious as to-day, the commission holds.

K. E. N. Cole has been appointed manager of the Van Buren branch of the Fort Smith (Ark.) Light & Traction Company.

M. L. Hibbard, manager of the Union Light, Heat & Power Company, Fargo, N. D., was elected president of the Associated Charities of Fargo for the year 1918.

D. T. Laylin, formerly in charge of the electrical department of Strong, Carlysle & Hammond, has been appointed electrical engineer for the Standard Parts Company of Cleveland.

Herbert J. Baker, who has been a manufacturers' agent for electrical equipment at Denver, Col., is now electrical and mechanical engineer for the Evergreen Mines Company at Apex, Col.

Harry A. Porter, president of Harry A. Porter, Inc., Chicago, and vice-president of the Chicago Club-Jovian League, has been elected chairman of the electrical subdivision of the Chicago Association of Commerce.

Frederick W. Johnson, advertising manager for the Puget Sound Traction, Light & Power Company, formerly at Bellingham, Wash., has been appointed assistant to E. C. Macy, in charge of all construction for the Stone & Webster Corporation in the Northwest, with general headquarters in Seattle. Mr. Johnson has been in the employ of the Puget Sound company since July, 1906, in various capacities.

Roy B. Woolley, now in the publicity and sales department of the Society for Electrical Development, has been appointed director of publicity of the society to succeed Harry W. Alexander, resigned. Mr. Woolley was formerly sales manager for the Standard Electric Stove Company, Toledo, and at one time associated with the MacManus-Kelley Company, Toledo, and the F. Bissell Company, Toledo.

Dr. F. G. Keyes, formerly chief engineer of the Cooper Hewitt Electric Company, Hoboken, N. J., has received the commission of captain in the chemical section of the National Army. Dr. Keyes severed his connection with the Cooper Hewitt company late in 1916 to take charge of physical chemistry at the Massachusetts Institute of Technology, although he was still engaged by the company in a consulting capacity.

Harry W. Alexander, director of publicity for the Society for Electrical Development, New York, has resigned to become assistant to the president on sales, American Writing Paper Company, New York and Holyoke, Mass. It was Mr. Alexander who as publicity manager of the society organized and successfully directed the work of the local committees and the publicity and sales work of both the "Electrical Prosperity Week" (1915) and "America's Electrical Week" (1916) campaigns. Prior to joining the staff of the society in 1914 he was sales manager of the Federal Light & Traction Company, having earlier been a financial and political writer in Chicago.

Men of the Industry

Changes in Personnel and Position—Biographical Notes

W. R. Putnam, district manager of the Utah Power & Light Company, has been made a director of the Utah Manufacturers' Association.

T. R. Steingoetter has been appointed manager of the Edwardsville (Ill.) office of the St. Louis County Gas & Electric Company. He has been serving this company as a traveling auditor and more recently as general auditor in East St. Louis. He began with this company as messenger boy in the Belleville (Ill.) office.

Prof. George F. Sever, formerly professor of electrical engineering and acting dean of the faculty of applied science at Columbia University and for over twelve years consulting electrical engineer for the department of water supply, gas and electricity in the city of New York, has been commissioned a major in the Engineer Officers' Reserve Corps, with headquarters in Washington, D. C. He has closed his engineering office in New York. Professor Sever first entered the teaching profession as instructor in the electrical engineering department of Columbia University after fifteen years of commercial experience, largely with the Thomson-Houston Electric Company. In 1900 he was promoted to be adjunct professor of electrical engineering, and five years later he became professor. He was a member of the commission appointed by Mayor McClellan to draw plans for a municipal lighting system for Greater New York. Professor Sever is the author of a number of books connected with the subject of electrical engineering.

Obituary

John P. Sparrow, chief engineer of the New York Edison plants, died on Monday at his home in Brooklyn, at the age of fifty-eight years.

Charles H. Williams, well known as a public utility operator, died in Denver, Col., on March 10 of pneumonia. Mr. Williams, who was forty-four years of age and a graduate of the University of Wisconsin in the class of 1896, was one of the first college engineers to work for Henry L. Doherty. This was with the Madison Gas & Electric Company in 1897. Subsequently he became general superintendent of that company, and in 1905 he was made manager of the Wisconsin Light & Power Company at La Crosse, Wis. Then he went west with the Northern Colorado Power Company. For the last half dozen years Mr. Williams has been engaged in building and operating gas and electric plants in the West.

Austin C. Dunham, who for many years was president of the Hartford (Conn.) Electric Light Company, during which time he was one of the recognized leaders in the central-station industry, died on Monday at St. Petersburg, Fla., at the age of eighty-five. Mr. Dunham retired from the presidency of the Hartford company in 1912 after a period of service extending over thirty years. During that time the Hartford Electric Light Company was constantly in the forefront in central-station advance and achievement. Because of Mr. Dunham's foresight and deep-founded faith in the future of the electric lighting industry, the Hartford company has the distinction of being the first to adopt modern methods of transmission of energy from water power, the first to use polyphase transmission apparatus and to introduce extensively alternating-current inclosed-arc lamps, 60-cycle rotary converters and the constant-current alternating arc-light system. It was also Mr. Dunham who led the way to the adoption of the steam turbo-generator as a part

A. C. DUNHAM

of regular central-station equipment and who besides launched the Nernst lamp into commercial being. In addition to these, the first storage battery used in connection with central-station service was installed at Hartford, as were also the first tungsten street lamps. In such manner did Mr. Dunham set the pace for the central-station industry. Mr. Dunham was born on June 10, 1833, in Coventry, and was graduated from Yale College in 1854. In addition to the central-station field, Mr. Dunham had been in the forefront in other industries, having been president of the Dunham Hosiery Company and the Rock Manufacturing Company, one of the founders of the Austin Organ Company and the Automatic Refrigerator Company, a director of the Aetna Insurance Company, the Travellers' Insurance Company, the National Exchange Bank of Hartford and the Cedar Hills Cemetery Association, besides having played a prominent part in the direction and management of many of the philanthropic activities that have figured largely in the life of Hartford.

TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

MOVEMENT TO DECREASE LOSS THROUGH FAILURES

New York Credit Men Give Further Evidence of Growing Tendency Toward Co-operation Within the Industry

Attention is now being directed by a special committee of the New York Electrical Credit Association toward preventing bankruptcies and minimizing losses through failures. The duty of this committee will be to aid in preventing failures wherever possible, and where failures are inevitable to study ways and means of conserving the assets which at that stage rightly belong to the creditors, promoting the most effective sale of the assets and expediting the distribution of dividends. Members of the association have been asked to lend their co-operation by placing before the committee, of which Franz Neilson is secretary, any information which tends to indicate the possible failure of a creditor in order that steps may be taken or, in case failure has already taken place, that the assets may be best conserved for those concerns.

This is but further evidence of the growing tendency throughout the industry to co-operate for the best interests of all. While the number of bankruptcies has not been particularly large, there is no desire on the part of any one to accept a loss where it can be prevented. Information given for the benefit of all will undoubtedly tend to minimize this loss.

Furthermore, there is always the added incentive that where failure impends the concern may be taken in hand promptly and through the injection of sound business principles be put on good footing in comparatively short time. Naturally where such results are achieved it is of advantage to the creditors not only in conserving their assets but also in continuing an outlet for their goods.

MAKING INTEREST CHARGE ON OVERDUE ACCOUNTS

Concerns That Have Had Experience in Following This Policy Declare It Speeds Up Collections and Reduces Credit Collection Cost

While the justice of charging interest on overdue accounts is pretty generally conceded, the question of policy is debatable. Aside from the fact that the policy of charging interest is not universal, about the only objection is the chance that the customer may impose more readily upon the seller, feeling that he is paying for the use of the additional time—that the seller is establishing banking facilities.

A certain Chicago jobbing house states that during its experience in charging interest a number of cases wherein the customer has stated by letter or stated to the salesman that he did not understand the attitude of the house in insisting on payment of interest on overdue accounts have arisen. As these cases have come up the house has taken great pains to explain intelligibly to the customer what prompts it to charge interest and what leads it to insist upon the payment of the account promptly even though interest is charged. In most cases it has been possible to convince the customer that the attitude of the house is proper. While this house feels that perhaps it should be conceded that the charging of interest on overdue accounts may have a tendency to increase the number of these, it is stated that this is only a tendency and not a certainty, if the situation is carefully watched and this tendency checked as it occurs. The surest way of checking it seems to be by letters of explanation to the customer, pointing out that the house is a mercantile institution and is not engaged in financing retail enterprises.

It has been stated that the charging of interest has been definitely found to have a good effect as a collection policy. The house making this statement charges interest from the last of the month following the month in which the goods were purchased, or, in other words, on accounts averaging forty-five days old. In this way the charge goes out at a time when the calling of the customer's attention to the account is very desirable and still at a time when it would not be possible to do this by letter. The charge follows the statement by a few days and goes before any follow-up letters on the account. Where an account first shows a tendency to become overdue, making this interest charge is thought to be the best possible way of jolting into the customer's consciousness the fact that he has exceeded the terms of sale to a point where he is not pursuing a fair, businesslike course.

By watching the results of this policy it has become evident that charging interest actually helps collections. Moreover, the total of the interest charges collected amounts to a respectable sum and is a material item in lowering the cost of handling credits and collections for the company. The interest charges canceled for any cause since the policy has been in effect by this house amount to from one-half to one-third of 1 per cent of the interest charged, and it is believed that this amount will become less and less as this policy becomes more common among jobbing houses.

WHAT THE JOBBER CAN DO TO CONSERVE LABOR

Labor Economies Can Be Effected and Better Business Methods Adopted if Employers Realize Obligations

At the annual meeting of the Pacific Coast Electrical Jobbers' Supply Association, held at Del Monte, Cal., E. J. Wallis, Pacific Coast manager of the Western Electric Company, read a paper on the conservation of labor, from which the following is taken:

"Labor is now employed under conditions more remotely removed from considerations of profit and compensation than ever before. The man who employs labor will feel the sense of responsibility that goes with a trust. He must use it without waste to the best advantage or be considered a slacker.

"Then there is work that has an apparent value but with which we may properly dispense at this time. Perhaps an elaborate acknowledgment of an order may be made simple or done away with entirely. We may have made it a practice to itemize a statement balance beyond the current month. There are some who are advocating now that statements be dispensed with altogether as most buyers pay individual bills and often merely a report of a balance would permit of sufficient check as between accounts. This might at least be done with some of our largest customers. Remittances are made without expectation of acknowledgment or receipts. A style of correspondence can be developed that works automatically to produce short concise letters and eliminate mere words and phrases like 'beg to advise' and 'beg to remain' and complimentary expressions. While we are going to be as courteous as ever, something more than has been the usual practice will have to be taken for granted.

"When there are changes in our organizations and men

leave for the country's service we will try by a detailed analysis of the jobs to determine if the work of, say, two experienced members of whom we are losing one cannot be carried on by the one of experience and two beginners, and for the beginners we may be able to substitute women. All prejudice against women at work has disappeared, and we are astonished at the tasks undertaken.

"We are working between ourselves so free an exchange of stock, not in quantities large but in articles and transactions numerous, that at some centers it would seem that our efforts tended to introduce something expensively better than a reasonably standard service. If we could organize an exchange that would hold forth for an hour or two each day, perhaps by telephone, we might possibly be able altogether to save a considerable amount of time and effort without inconvenience to our customers.

"The character and expense of a sales department in a supply jobbing business is determined as a judgment of the executives of the business. The foundation of the decision will be the amount of sales to which the business aspires.

"The amount of our sales promotion expense will depend on our ambition with respect to the desired volume for our business, and that volume is really our opinion of what is our proper proportion of the total possibilities in our territory. If the determination is reached to attain a greater volume under existing conditions, a larger percentage of realization on the possibilities is of course necessary. It is well to keep in mind that a larger percentage of realization on available business is possible even with a decreased volume of business. If this is not appreciated, an increased and unproductive sales promotion expense may be incurred on the supposition that we are losing our share when the contrary is the true condition.

"The extent to which a jobber will incur sales promotion expense will also depend on the amount and character of the service he figures he can profitably give a manufacturer by introducing new lines, novelties and specialties. Most electrical specialties are labor savers and as such can be introduced as an answer to the labor problem. But those devices that are not labor savers, or those articles that expect a market only to the extent that they can displace some older and more standard device, will probably be classified as luxuries, and the buying public is now being educated against any but justifiable and necessary expenditures."

METAL MARKET SITUATION

Attempts to Have Price of Copper Advanced Officially Will Be Futile—Other Metals Unchanged

It is admitted that the demand for copper for industrial or commercial purposes is being easily met. This is reflected in the reduction in the price of wire base. Producers are endeavoring to have the government or official selling figure of the metal increased at the expiration of the present arrangement, but those in a position to know say the present quotations for the metal will remain unchanged. The sale of rubber-covered, cable and weatherproof wire is active, largely for government work.

No change of any consequence is noted in the old metals market, and the demand is light.

NEW YORK METAL MARKET PRICES

	March 11	March 18
Copper:	£ s d	£ s d
London, standard spot	110 0 0	110 0 0
Prime Lake	Govt. price 23.50	Govt. price 23.50
Electrolytic	Govt. price 23.50	Govt. price 23.50
Casting	Govt. price 23.50	Govt. price 23.50
Wire base	26.25 to 26.75	26.25 to 26.75
Lead, trust price	7.25	7.25
Nickel, ingot	50.00	50.00
Sheet zinc, f.o.b. smelter	*15.00	*15.00
Spelter, spot	7.67½ to 7.72½	7.55
Tin, Straits	*85.00	*85.00
Aluminum, 98 to 99 per cent.	Govt. price 32.00	*Govt. price 32.00

OLD METALS

Heavy copper and wire	21.50 to 22.00	21.50 to 22.00
Brass, heavy	14.00 to 15.25	14.00 to 15.25
Brass, light	10.00 to 11.00	10.00 to 11.00
Lead, heavy	6.25 to 6.50	6.25 to 6.50
Zinc, old scrap	5.50 to 5.75	5.25 to 5.75

*Nominal.

THE WEEK IN TRADE

LITTLE change is noticed in the week's total volume of trade. With the exception of the Far West, building continues slow. The dearth in building has given rise to a very slow movement of stocks normally used by electrical contractors. Delivery conditions show slight improvement here and there. Jobbers' stocks on the whole seem to be in good condition. With the approaching third Liberty loan credits and collections show no appreciable change.

Prices are holding unusually steady. Some lines are advancing, but there are indications of a deterioration of peak prices beginning to set in. Wire is much lower than it was a year ago; for instance, conduit last week softened a few points. Fixtures, it is reported this week, have dropped below the figure at which market quotations for them have recently been made.

NEW YORK

Sellers and receivers of electrical goods, while agreeing that shipping and delivery conditions are improving, are still of the opinion that transportation facilities are far from satisfactory. Hereabouts factory shipments, unless from Connecticut, are delayed, so that stocks in certain lines are greatly depleted. With building operations almost wholly suspended the outlet for many staples is practically closed, or, as one large jobber explained, there is very little regular trade just now. What is going on is what is described as special—that is, government—orders, and they are tremendous in size, the requirements about keeping the nearby market cleaned up on many items. Jobbers, however, are very optimistic. Some price revisions have taken place, but it seems to be the opinion that they are at peak, excepting when it comes to prompt deliveries, and then the quotations for quick service are reported as advancing rapidly.

Collections are rather backward, and the granting of credits is restricted. Trade acceptances are not making the headway desired by distributers and jobbers.

SOLDERING IRONS.—A higher scale of prices, effective April 1, was announced last week on electric soldering irons under the Hoskins schedule.

INSULATORS.—All grades, glasses, sizes and makes are reported at a low level. There is plenty of stock at the mills, but the embargoes have shut off deliveries, which are six and eight months behind.

COLLECTIONS AND CREDITS.—Jobbers, with few exceptions, speak of collections as being slow. Credits remain restricted, and there is a greater volume of cash business than any one can readily recall.

ELECTRIC RADIATORS.—The market having been caught up with, stocks are in full supply again. In fact, reports of an overstock are heard, with a possibility of the goods having to be carried over for the following season's trade.

CONDUIT.—A shortage in all sizes is mentioned as a general condition. Traffic congestion is said to be the basic cause. Four or five cars a day will arrive here, jobbers state, and then there will be none for a couple of months.

ELECTRIC RANGES.—Activity is reported in this line with the approach of warmer weather. Twenty-four heavy-duty electric ranges, capable of taking care of 250 men and costing $500 each, were purchased by the Navy Department last week.

FAN MOTORS.—Reports of a threatened scarcity in fan motors are in circulation. Some manufacturers are urging

jobbers not only to specify their requirements promptly but also to accept shipments at once. It is said that unless cars are plentiful the War Industry Board may interdict all shipments. Stocks are said to be light in this territory, excepting in the case of special company agents. One prominent jobber who has the promise of three cars by May 1 is doubtful whether the delivery will be made. If the situation becomes acute on this account, a further advance in price may be realized.

ATTACHMENT PLUGS.—These goods are in ample supply, as they are easily obtainable from nearby factories in New England.

CABLE.—No building of any account being under way, there is little sale and stocks are heavy with jobbers and dealers.

SMALL MOTORS.—Shipments out of stock are prompt for small motors up to 75-hp. and have been improving. No change in price has occurred.

INDUSTRIAL AND STREET-LIGHTING FIXTURES.—Owing to lack of building operations, sales are far below the average. Factory deliveries are behind three months. Within a few weeks a reduction in price ranging from 5 to 10 per cent has been reported.

HOUSEHOLD SPECIALTIES.—With the growing sales in seasonable articles in this line, such as electric irons, sewing and washing machines, the trade expects stll further developments. So far prices have not been affected, and no change is looked for unless the metal market takes an unfavorable turn. A vacuum-cleaner manufacturer, owing to lack of raw material and labor restrictions, has been obliged to hold in abeyance his plan of carrying a full line of household appliances.

CHICAGO

An investigation of business conditions in the territory surrounding Chicago shows markedly the effect of the war on trade. Building activities, except of the industrial sort, are almost nil. The industrial building, however, is on a grand scale. The electrical trade, except that part which relies entirely for its activity on residential building, is very active. Even the contractors with no stores are making out very well by taking up farm-lighting work.

CONDUIT.—The drop in price has in no way affected the conditions of supply and demand. In some places in the Chicago territory jobbers did not make the reduction until more than two weeks after the drop by the manufacturers.

CIRCUIT BREAKERS.—Deliveries from some factories are very slow. Some agents cannot quote better than three months.

TRANSFORMERS.—There is a steady demand by industrial companies.

SOCKETS.—Porcelain sockets have increased slightly in price.

SEWING MACHINES.—The Western Electric Company has increased the retail price of its motor-driven sewing machines $2.50 per machine.

DOMESTIC APPLIANCES.—The Stirling Electric Company of Minneapolis, a jobbing and dealing concern, has just signed contracts for purchasing washing machines and vacuum cleaners to the aggregate amount of $1,000,000. The vacuum-cleaner contract is for 9000 machines. It was made with the Ohio company and covers three years' purchases. The washing-machine contract was made with the Gainaday company and terminates in five years. Under its terms the Stirling company is to take 1800 machines this year and is to increase its quota 10 per cent each year, making a total of about 11,000 machines in five years. The contracts do not protect either party as to price, but do give protection on agency, territory and delivery.

FARM LIGHTING.—It is reported that one large company is shipping only one-third of its sales. Other companies are also having trouble getting out enough machines to meet the demand. Electrical dealers everywhere are entering this field of sales in an endeavor to bolster up the business lost because of the falling off in building.

BOSTON

Trade continues in heavy volume, but with jobbers reporting spotty days and a demand that is hard to forecast. Stocks are fairly full at present, despite the handicap of poor transportation conditions. Here and there signs of freer movement of freight on the railroads are to be seen. The coal crisis appears past, normal business hours continue, and more punctual passenger train movement is being experienced. Labor conditions are better than last week, the strike of textile firemen at Fall River being short-lived. The next draft is expected to cut heavily into New England resources in man-power, but time for readjustments mitigates the severity of labor withdrawals from civil life. Collections are good among the manufacturing buyers, but still somewhat slow among the small contractors. The granting of increased freight rates to the Eastern railroads will stimulate general business without question.

There is a strong undercurrent of feeling that the extremely conservative policy of central stations regarding new business will have to yield in the near future to a more liberal one. The pressure of the public for service beyond previously standardized lines is increasing and must be met. Improving relations between central stations and contractors are indicated by the recent establishment of a contact committee representing the New England Section of the N. E. L. A. and the Electrical Contractors' Association of Massachusetts, scheduled to hold a meeting in Boston this week. Prices show little change this week compared with last, but the rising cost of cotton tends toward the lessening of discounts on cable.

HEATING DEVICES.—There appears to be a temporary lull in this class of business, but with the approach of warmer weather a large turnover is expected. Irons are moving well, one jobber reporting that nearly as many units have been ordered since Feb. 1 by certain local purchasers for deferred billing or deferred shipments as were booked from these buyers all through 1917.

MOTORS.—Trade is as heavy as last year, which is saying a good deal. The demand for large motors is literally enormous, units up to 2000 hp. being sought for work related to the war. A better tone appears in the central-station field, notably among hydroelectric companies, which are inquiring more generally for equipment to meet increasing power demands. Prices remain steady and deliveries are better in the smaller sizes. Some stock deliveries have been made lately in sizes ranging from 10 hp. or 7.5 hp. down. Some gaps exist in the lists of available motors, but strenuous efforts to increase factory production are bearing fruit.

TRANSFORMERS.—Deliveries are improving, notably in sizes below 200 kw., where quotations are being made on a two to three months' basis. Below 100 kw. deliveries run from stock shipments to eight weeks. Prices are firm, with no prospect of early change.

METERS.—Large stocks of meters for house lighting are now on hand at the factories, ready for immediate shipment. The demand is rather small at present, and if the housing program in connection with shipyard expansion goes into effect soon, the meters will be "on the job" about as soon as any fittings needed. Prices remain unchanged.

LAMPS.—Conditions are constantly improving, and reserve stocks are now being accumulated in connection with some large orders by central stations which have as yet not been obliged to draw their full commitments from the manufacturers. The 50-watt tungsten lamp is growing in popularity and bids fair to drive the 40-watt and 60-watt units out of the field in due time. "Hooverizing" on light at one end and increased factory facilities at the other are putting a new face upon the lamp supply situation, which but a few weeks ago gave cause for considerable anxiety.

WASHERS.—Popular interest continues in these equipments; the installment plan of sales always appeals to the public, and the lifting of railroad embargoes has begun to help deliveries.

WIRE AND CABLE.—Orders are increasing slightly. Prices remain firm, with a tendency toward discount reductions due to the steady rise in cost of cotton. This is less pronounced in the larger sizes of cable on account of the

higher relative cost of copper. Deliveries are now fairly good. One manufacturer believes that the volume of business which could be realized from shipyard house wiring is nominal from the wire manufacturer's standpoint, pointing out that a million feet of No. 14 wire can be produced by a single factory in a week—an amount which would go a long way toward over-supplying the expected demand from the above source.

CONTRACTING CONDITIONS.—Despite the low volume of building wiring work now seen, contractors are in many cases doing an excellent business in industrial wiring. In the Berkshire Hills district of Massachusetts, for example, many textile and paper products bearing upon war work are being turned out, and local jobbers and wiring establishments report great activity. Larger sizes of conduit for such work have been purchased at high prices from the jobbers. An unusually busy branch of wiring work now being handled by some contractors is the rewinding of railway motor armatures for trolley roads suffering from burnouts in recent heavy snows. Armatures have been burned out literally by the hundred this winter, and electrical repair houses capable of this class of rewinding are taking over not a little work which cannot be handled quickly enough by the street-railway repair shop itself on account of the excessive amount of motor trouble experienced.

ATLANTA

Governmental activity in shipbuilding, nitrate and powder distillate plants, together with contemplated cantonment extensions and additional construction for aviation purposes, is the overshadowing feature in trade lines at this time. A number of readjustments of outputs of divers industries are still being made in conformity with the exigencies of war, but the general order of things is forward. Meanwhile the magnitude of government requirements in textiles is illustrated anew by reports that 65 per cent of mill capacity is engaged in this business. Charleston, S. C., has definitely been selected by the Shipping Board as the site of one of the two additional shipbuilding yards to be constructed on the South Atlantic Coast. Twelve 9500-ton steel ships will be built at these yards. No definite information is at hand, but it is expected that the other yard will be located at Brunswick, Ga.

A considerable quantity of large apparatus has been contracted for lately, and where the shipment on turbines appeared to be unreasonable large direct-connected engine units have been purchased. Two 4000-kw. turbines have been ordered for the Tennessee Coal & Iron Company's Mobile shipyard. Transformers, switchboards and motors have also been contracted for to take care of the initial installation at Muscle Shoals. A large volume of general supply business is being done at Hadley's Bend, near Nashville, Tenn., for the new powder plant. This condition applies as well to Muscle Shoals.

Manufacturers carrying a general line of supplies are stocking large quantities of marine goods with Atlantic Coast jobbers to handle the present and future extensive demand for this class of material.

ELECTRIC RANGES.—The volume of business is very satisfactory and a steady increase in the demand is noted. Taken as a general average, deliveries are slowing up, and this feature has tended to dampen enthusiasm in certain quarters.

WIRE.—There is a very substantial demand for both rubber-covered and weatherproof. No material change in price has been recorded since the sag several months ago. Deliveries are fair. Stranded goods are hard to get.

KNIFE SWITCHES.—The volume of sales continues steady and local stocks are moving freely. Shipments are arriving steadily.

FUSES.—Activity in this line is about the same. A great number of the motors sold in this territory are provided with overload relays; this feature in itself has tended to offset any increased demand. Shipments are coming in promptly.

INTERPHONES.—Demand is fair, but nothing like the late 1917 business is being transacted. Government demands and restrictions on this type of apparatus, together with very poor deliveries, have curtailed inquiries and, besides, jobbers and manufacturers are not going after this trade.

SEATTLE

Sales of power apparatus to the new shipyard in Everett and heavy demand for large-sized lamps and floodlighting outfits to yards in the Columbia River district particularly featured the week's business. Jobbers report a noticeable easing up of shipments in conduit and power apparatus. The conduit situation has been serious for months. Arrivals during the week will help temporarily, for the present relief in the freight situation is believed to be but temporary. Government buying for navy yard and cantonments has increased considerably in the past two weeks. The inability of jobbers to obtain deliveries is forcing them to place larger orders to keep stocks filled; merchandise investment therefore has increased materially and nothing like the turnover desired can be expected. Residence building in Puget Sound cities and in Columbia River districts continues exceedingly active. In Seattle and Tacoma building is particularly heavy. Building on a considerable scale has begun in Portland, and real estate values are increasing rapidly. The scarcity of housing facilities for shipyard employees at Astoria, Aberdeen, Hoquiam and other wooden shipbuilding centers is serious. The demand for houses in Spokane cannot be met. Dealers in the Northwest report to jobbing houses a constantly increasing demand for fixtures and house-furnishing material. The movement is expected to reach its peak in early summer, according to conservative jobbers. Some believe demand will continue until winter.

According to statements made by prominent lumbermen, under the eight-hour basis recently adopted lumber production has decreased 10 per cent. Many manufacturers declare that the next few months will show a decrease of 20 per cent. Sawmills in northern Washington on the eight-hour basis are equaling and in some cases exceeding the average output under the ten-hour schedule.

Rigorous steps by railways to stop accumulations of export freight for which no steamship accommodations have been arranged from reaching Seattle are being taken, and the railways may be asked to compel every shipper of export freight in the East to file an affidavit stating that he has secured steamship space on Puget Sound before he will be permitted to load a car.

Lamps of larger sizes are more difficult than ever to obtain, with stocks very low. Sixty-watt sizes and less are coming from factories, giving much easier stocks. The demand from shipyards has been very heavy. Power apparatus is temporarily loosening up because of shipments from the East. Inquiries and orders have been heavy during the past month, motor sales of medium sizes especially increasing rapidly, particularly in the Spokane and Portland territories. Sales to government increased slightly.

SAN FRANCISCO

The past week has been prolific in large jobs of a miscellaneous character. The Hercules Powder Company is adding a new unit to its plant. The city of Sacramento has let a contract for the construction of a new agricultural pavilion to house its annual fair, the electrical work alone being an $8000 job. Fresno will construct a new 350-room hotel. The Bay Point shipyards will be protected by a new fire protection system utilizing a 50,000-gal. storage tank.

Credit managers report that collections are fairly easy but require careful nursing.

The Pacific Gas & Electric Company has changed its plan of a co-operative range campaign with the assistance of electrical dealers. The new schedule provides for sale to consumers at current list prices with a $20 allowance for wiring and a 5 per cent cash discount for prompt payment. The installation will be done at the purchasers' expense with the exception of this $20 allowance, and the power company plans to furnish contractors with special types of fuse blocks and double-throw switches, if required, at their cost plus 10 per cent. The customer will make four monthly payments.

Current Prices of Electrical Supplies

New York and Chicago Quotations

THE prices quoted are those prevailing in standard packages of specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists of contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit. Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the sources of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers. Price variations may be due to difference in grade of products of different manufacturers, to local conditions, or to both.

ARMORED CONDUCTORS, FLEXIBLE STEEL

Single-Conductor

B. & S. Size	List per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT.—NEW YORK

Single-Conductor

	No. 14 Solid
Less than coil	List to $61.00
Coil to 1000 ft	10% to 59.17
	No. 12 Solid
Less than coil	List to $71.00
Coil to 1000 ft	—10% to 68.87

Twin-Conductor

	No. 14 Solid
Less than coil	List to $105.00
Coil to 1000 ft	$70.00 to 10%
	No. 12 Solid
Less than coil	List to $135
Coil to 1000 ft	10% to $130.95

DISCOUNT—CHICAGO

Single-Conductor

	No. 14 Solid
Less than coil	15% to + 20%
Coil to 1000 ft	10% to 20%
	No. 12 Solid
Less than coil	15% to + 20%
Coil to 1000 ft	— 10% to 20%

Twin-Conductor

	No. 14 Solid
Less than coil	15% to $115
Coil to 1000 ft	— 20% to $80
	No. 12 Solid
Less than coil	List to + 20%
Coil to 1000 ft	— 20% to 10%

ATTACHMENT PLUGS

List ranges from $0.22 to $0.30 each. Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	10% to $24.00
1/5 to std. pkg	20% to 19.80
Std. pkg.	34% to 18.75

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+ 20% to 12%
1/5 to std. pkg	20% to List
Std. pkg.	28% to 44%

BATTERIES, DRY

NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.40	$0.40
12 to 50	.35	.35
50 to barrel	.31	.32
Barrel lots	.28 to .285	.29 to .295

CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.40	$0.40
12 to 50	.35	.35
50 to barrel	.3175-.3195	.3215-.3295
Barrel lots	.2875-.2895	.2915-.2995

CONDUIT, METALLIC FLEXIBLE

Size, In.	Ft. per Coil	List, per 100 Ft.
5/16	250	$5.00
3/8	250	7.50
1/2	100	10.00
3/4	50	13.00
1	50	21.00
1 1/4	50	26.00
1 1/2	25–50	35.00
2	25–50	45.00
2 1/2	25–50	52.00

NET PER 1000 FT.—NEW YORK

	Less Than Coil	Coil to 1000 Ft.
3/8-in. s. stp.	Net to $75.00	—15% to $69.75
3/8-in. d. stp.	10% to 75.00	List to 72.00
1/2-in. s. stp.	List to 100.00	—15% to 93.00
1/2-in. d. stp.	10% to 100.00	List to 96.00

NET PER 1000 FT.—CHICAGO

	Less Than Coil	Coil to 1000 Ft.
3/8-in. single strip	$75.00	$63.75
3/8-in. double strip	78.25-78.75	71.25-71.75
1/2-in. single strip	100.00	85.00
1/2-in. double strip	105.00	95.00

CONDUIT, NON-METALLIC FLEXIBLE

Size, In.	List per Foot	Size, In.	List per Foot
7/32	$0.05 1/2	1	$0.25
1/4	.06	1 1/4	.33
3/8	.09	1 1/2	.40
1/2	.12	1 3/4	.47
5/8	.15	2	.55
3/4	.18	2 1/4	.65

NET PER 1000 FT.—NEW YORK

	Less Than $15 List	$15 to $60 List	$60 to $150 List
7/32-in.—	$25.00-$55.00	$20.50-$24.50	$20.00-$21.50
1/4-in.—	$28.00-$60.00	$22.50-$27.00	$22.00-$23.50

NET PER 1000 FT.—CHICAGO

	Less Than $15 List	$15 to $60 List	$60 to $150 List
7/32-in.—	$36.00-$55.00	$25.00	$22.50
1/4-in.—	$40.00-$66.00	$27.00	$25.00

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON

Card No. 38

Size, In.	Conduit, List per Foot
1/4	$0.08 1/2
3/8	.08 1/2
1/2	.08 1/2
3/4	.11 1/2
1	.17
1 1/4	.23
1 1/2	.27 1/2
2	.37
2 1/2	.58 1/2
3	.76 1/2

	Couplings, List	Elbows, List
1/4	$0.05	$0.19
3/8	.06	.19
1/2	.07	.19
3/4	.10	.25
1	.13	.37
1 1/4	.17	.45
1 1/2	.21	.50
2	.28	1.10
2 1/2	.40	1.80
3	.60	4.80

DISCOUNT—NEW YORK

	1/4 in. to 1/2 in.	3/4 in. to 3 in.
Less than 2500 lb.	4% to 10%	7% to 12%
2500 to 5000 lb.	6% to 9%	9% to 15%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	1/4 in. to 1/2 in.	3/4 in. to 3 in.
Less than 2500 lb.	3.7% to 5.3%	5.7% to 7.3%
2500-5000 lb.	6.7% to 8.3%	8.7% to 10.3%

(For galvanized deduct six points from above discounts.)

FLATIRONS

NEW YORK

List price	$5.00 to $6.00
Discount	30%

CHICAGO

List	$5.00 to $6.00
Discount	25% to 30%

FUSES, INCLOSED

250-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.25
35-amp. to 60-amp.	100	.35
65-amp. to 100-amp.	50	.90
110-amp. to 200-amp.	25	2.00
225-amp. to 400-amp.	25	3.60
450-amp. to 600-amp.	10	8.50
600-Volt		
3-amp. to 30-amp.	100	$0.40
35-amp. to 60-amp.	100	.60
65-amp. to 100-amp.	50	1.50
110-amp. to 200-amp.	25	2.50
225-amp. to 400-amp.	25	5.50
450-amp. to 600-amp.	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	28%
1/5 to std. pkg.	38%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	28%
1/5 to std. pkg.	38%

FUSE PLUGS

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg.	$5.00 to $5.75
1/5 to std. pkg.	4.50

Standard packages, 500. List, each, $0.07.

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg.	$6.25
1/5 to std. pkg.	5.25

Standard packages, 500. List, each, $0.07.

LAMPS, MAZDA

105 to 125 Volts

	Std. Pkg.	List, Each
Regular, clear:		
10 to 40-watt—B	100	$0.30
60-watt—B	100	.35
100-watt—B	24	.70
75-watt—C	50	.70
100-watt—C	24	1.10
200-watt—C	24	2.20
300-watt—C	24	3.25
Round bulbs, 3⅛ in., frosted:		
15-watt—G 25	50	.53
25-watt—G 25	50	.55
40-watt—G 25	50	.55
Round bulbs, 3¾ in., frosted:		
60-watt—G 30	24	.77
Round bulbs, 4⅝ in., frosted:		
100-watt—G 35	24	1.10

DISCOUNT—NEW YORK

Less than std. pkg.	Net
Std. pkg.	10%

DISCOUNT—CHICAGO

Less than std. pkg.	Net
Std. pkg.	10%

LAMP CORD

Cotton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$24.90 to $31.00
Coil to 1000 ft.	22.72 to 27.90

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$29.00 to $30.00
Coil to 1000 ft.	21.50 to 22.50

LAMP GUARDS, WIRE

Standard packages from 50 to 150

NEW YORK

Net per 100	$20.00 to $29.00

CHICAGO

Net per 100	$19.17 to $21.75

OUTLET BOXES

Nos.	List, per 100
101—A, A1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200 S.E., 300, AX, 1½, 4 S	30.00
103—C.A., 9, 4R, B 1½	25.00
106—F.A., 7, C.S., 1½, 3 R.	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list.	25%-37%	20%-32%
$10.00 to $50.00 list.	42%-45%	37%-40%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list.	40%	35%
$10.00 to $50.00 list.	50%	45%

PIPE FITTINGS

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	10%
1/5 to std. pkg.	20%
Std. pkg.	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	10%
1/5 to std. pkg.	20%
Std. pkg.	30%

PORCELAIN CLEATS—UNGLAZED

2 and 3 Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg.	$20.00 to $38.00
1/5 to std. pkg.	19.00 to 20.00

Standard package, 2200. List per 1000, $20.

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg.	$15.80
1/5 to std. pgk.	14.80

Standard package, 2200. List per 1000, $20.

PORCELAIN KNOBS

NEW YORK

Per 1000 Net	Std. Pkg. 3500 5½ N. C.—Solid Nail-it	Std. Pkg. 4000 N.C.
Less than 1/5 std. pkg.	$27.50 to $29.00	$30.75
1/5 to std. pkg.	15.60 to 20.75	24.20

CHICAGO

Per 1000 Net	Std. Pkg. 3500 5½ N. C.—Solid Nail-it	Std. Pkg. 4000 N.C.
Less than 1/5 std. pkg.	$11.85	$30.75
1/5 to std. pkg.	11.10 to 11.40	24.20

SOCKETS AND RECEPTACLES

	Std. Pkg.	List
⅛-in. cap key and push sockets.	500	$0.33
⅛-in. cap keyless socket.	500	.30
⅛-in. cap pull socket.	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	Net to $23.00
1/5 to std. pkg.	20% to 21.00

NET PER 100—CHICAGO

Less than 1/5 std. pkg.	24% to $25.00
1/5 std. pkg.	30% to 23.00

SWITCHES, KNIFE

250-Volt, Front Connections, No Fuse

High Grade:	
30-amp. S. P. S. T.	$0.80
60-amp. S. P. S. T.	1.20
100-amp. S. P. S. T.	2.25
200-amp. S. P. S. T.	3.48
300-amp. S. P. S. T.	5.34
30-amp. D. P. S. T.	1.20
60-amp. D. P. S. T.	1.78
100-amp. D. P. S. T.	3.38
200-amp. D. P. S. T.	5.20
300-amp. D. P. S. T.	8.00
30-amp. 3 P. S. T.	1.80
60-amp. 3 P. S. T.	2.68
100-amp. 3 P. S. T.	5.08
200-amp. 3 P. S. T.	7.80
300-amp. 3 P. S. T.	12.00
Low Grade:	
30-amp. S. P. S. T.	0.42
60-amp. S. P. S. T.	0.74
100-amp. S. P. S. T.	1.50
200-amp. S. P. S. T.	2.70
30-amp. D. P. S. T.	0.68
60-amp. D. P. S. T.	1.22
100-amp. D. P. S. T.	2.50
200-amp. D. P. S. T.	4.50
30-amp. 3 P. S. T.	1.02
60-amp. 3 P. S. T.	1.84
100-amp. 3 P. S. T.	3.76
200-amp. 3 P. S. T.	6.76

DISCOUNT—NEW YORK

	High Grade
Less than $10 list	List to + 5%
$10 to $25 list	11%
$25 to $50 net	14% to 15%
	Low Grade
Less than $10 list	5% to 10%
$10 to $25 list	16%
$25 to $50 list	24% to 25%

DISCOUNT—CHICAGO

	High Grade
Less than $10 list	+5%
$10 to $25 list	11%
$25 to $50 list	—14%
	Low Grade
Less than $10 list	5%
$10 to $25 list	—16%
$25 to $50 list	24%

SWITCHES, SNAP AND FLUSH

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind.	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind.	100	.54
5-amp. three-point	100	.54
10-amp. three-point	50	.76
10-amp., 250-volt, D. P.	100	.66

SWITCHES, SNAP AND FLUSH—Cont'd

10-Amp. 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	.70
10-amp. double-pole	50	.70

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	List
1/5 to std. pkg.	15%
Std. pkg.	28%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	+20% to list
1/5 to std. pkg.	List to —15%
Std. pkg.	List to 30%

SWITCH BOXES, SECTIONAL CONDUIT

Union and Similar—	List Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	List	Net
$2.00 to $10.00 list	10% to 20%	5%
$10.00 to $50.00 list	20% to 30%	15%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $2.00 list	25%	15% to 20%
$2.00 to $10.00 list	25%	20%
$10.00 to $50.00 list	25% to 35%	20% to 25%

TOASTERS, UPRIGHT

NEW YORK

List price	$6.00
Discount	30%

CHICAGO

List price	$4.50 to $6.00
Discount	25% to 30%

WIRE, ANNUNCIATOR

NET PRICE—NEW YORK

	Per Lb. Net
No. 18, less than full spools	$0.44¼
No. 18, full spools	0.43¼

CHICAGO

	Per Lb. Net
No. 18, less than full spools.	$0.57½ to $0.65
No. 18, full spools.	0.55½ to 0.55

WIRE, RUBBER-COVERED, N. C.

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
11	$15.00-$18.00	$13.00	$10.25-$11.50
12	23.25- 25.41	21.30- 21.78	15.97- 19.35
10	32.40- 35.21	29.70- 30.18	22.13- 27.00
8	45.70- 49.12	41.90- 42.12	30.88- 38.00
6	72.40- 77.84	66.35- 66.72	48.93- 60.30

CHICAGO

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 2500 Ft.	2500 to 5000 Ft.
14	$18.00	$13.00	$11.50
12	25.33-$26.25	22.02-$25.33	18.35-$20.40
10	30.48- 36.54	27.44- 31.26	22.86- 29.23
8	42.54- 51.57	38.99- 44.13	31.90- 41.36
6	67.46- 88.38	56.15- 75.61	50.53- 56.39

WIRE, WEATHERPROOF

Solid-Conductor, Triple-Braid, Size 4/0 to 8 Inc.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb.	$33.25 to $35.25
25 to 50 lb.	31.25
50 to 100 lb.	28.25 to 34.25

CHICAGO

	Per 100 Lb. Net
Less than 25 lb.	$35.42 to $40.35
25 to 50 lb.	34.42 to 39.35
50 to 100 lb.	33.42 to 38.35

NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Convertible Electric Lantern

An electric lantern shown herewith operating on a standard flashlight battery is manufactured by the Lindstrom-Smith Company, Chicago. The battery is of sufficient size to give twenty hours of continuous use or forty hours of intermittent service. It is estimated that it will supply light ten minutes a day for eight months. The entire outfit weighs 24 oz. (680 g.), and is 6 in. (15.2 cm.) by 5.5 in. (14.0 cm.) over all.

BATTERY SUFFICIENT FOR TWENTY-HOUR CONTINUOUS USE

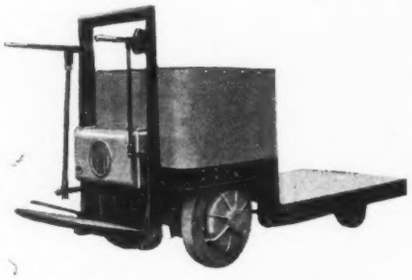
Artificial Load for Testing

The illustration reproduced herewith shows a portable "phantom" load manufactured by the Western Electro Mechanical Company, Oakland, Cal. It is used as an artificial non-inductive load for testing alternating-current watt-hour meters in conjunction with a rotating standard or an induction wattmeter. A compression-type carbon rheostat which, it is claimed, will maintain any current between zero and full value is mounted on the side of the device in series with the secondary. The rheostat is an integral part of the cast case. The equipment is made in ratings of 10 amp., 25 amp. and 50 amp. The 110-220-volt and 220-440-volt equipments are made in these sizes.

PORTABLE LOAD FOR TESTING WATT-HOUR METERS

Industrial Electric Truck

The industrial electric truck of the motor-in-wheel type, illustrated herewith, has been designed by the C. W. Hunt Company, Inc., West New Brighton, N. Y., and is known as the company's type DF-60. It is built with a drop frame of 4-in. (10-cm.) heavy steel channels, the capacity of the truck being 4000 lb. (1814 kg.). As marketed it is equipped with either thirty Edison G-6 cells or twenty MV-11 "Ironclad Exide" cells. The battery is mounted in a box with recoil spring supports above and below and is placed directly over the driving wheels, insuring maximum tractive effort. In each of the 20-in. (50.8-cm) driving wheels is mounted a 35-volt, 30-amp., 1000-r.p.m. series-wound motor, this method of driving enabling the truck to overcome obstacles to a degree which is unusual.



MOTOR-IN-WHEEL TYPE OF TRUCK

Series-parallel control is provided, with a range of from 2 miles to 7 miles (3.2 km. to 9.6 km.) per hour in both forward and reverse. The controller, cut-out, fuse and charging socket are mounted in a dust-proof case on the front of the frame, and the operating platform is so designed that when the driver steps off the platform the circuit is immediately opened. Similarly, if the operator removes his foot from the brake pedal, the brakes are immediately applied. The driving wheels are equipped with New Departure ball bearings and 3½-in. by 20-in. (8.9-cm. by 50.8-cm.) solid-rubber tires. The rear or trailing wheels are equipped with 5-in. by 10½-in. (12.7-cm. by 26.7 cm.) solid-rubber tires and Bock roller bearings. The armatures in these machines are of the same diameter as in heavy road trucks of the motor-in-wheel type, but are slightly foreshortened on account of the necessary space requirements.

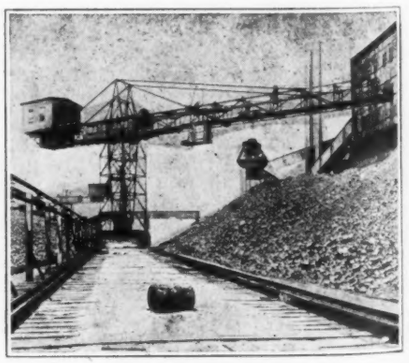
Two pinions and shafts engage with an equalizing member, applying their power through a gear rack at the periphery of the wheel. The platform, of ⅜-in. (0.95-cm.) steel plate is only 11 in. (27.9 cm.) from the floor, and is 37 in. by 60 in. (94 cm. by 164 cm.) in size. A cover of ¼-in. (0.6-cm.) checkered steel plate is also provided for the battery box, thereby affording additional carrying space. This truck has an over-all length of 106 in. (269.2 cm.), a width over all of 37¾ in. (95.8 cm.), and an over-all height of 52¼ in. (132 cm.). The turning radius of the outside wheels is 5 ft. 8 in. (1.5 m.), and the truck is of unusually rugged and simple design, built to withstand heavy loads and to operate in narrow and congested areas.

Battery Switch

The Fahnestock Electric Company of Long Island City, N. Y., has recently developed a wooden-base battery switch equipped with Fahnestock spring-clip binding posts. This switch is made in both one and two points. The use of the spring-clip post eliminates all use of tools, it is pointed out, and the device can be wired up instantly. All metal parts of the switch are nickel-plated and are held to the wooden base by means of nickel-plated brass eyelets, eliminating the possibility of loosening.

Large-Size Electric Crane

The electric crane shown in the accompanying photograph is used by the LaBelle Iron Works plant at Steubenville, Ohio, and is equipped with General Electric motors. The hoisting is accomplished by a 375-hp. slip-ring induction motor directly coupled to a 40-



DYNAMIC BRAKING USED EFFECTIVELY ON ELECTRIC CRANE

hp. direct-current motor. The crane will hoist a 14-ton bucket of coal at 500 ft. (152 m.) per minute. The feature of the machine is the dynamic braking obtained by combining the direct-current motor with the alternating current one so that the direct-current unit serves as an exciter. The dynamic braking arrangement here used for the first time on cranes of this size is economical on first cost and has a number of practical operating advantages. Creeping speeds of 110 ft. (33.5 m.) per minute for lowering are obtainable with this crane under ordinary service conditions.

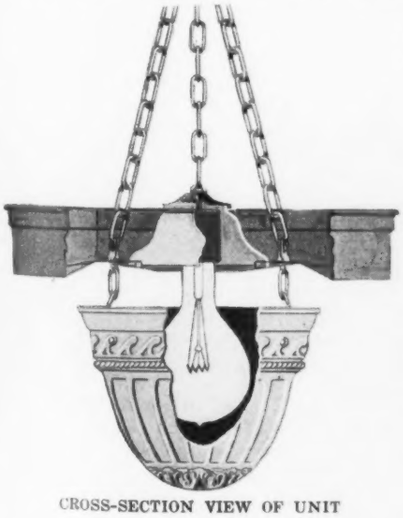
Home Motor

The A. C. Gilbert Company of New Haven, Conn., has developed a home motor that is easily convertible and with different attachments can be made to churn butter, whip cream and eggs, etc.; polish silver and sharpen knives. It can also be furnished with a vibrator attachment for massage or converted into an electric fan by attaching guard, blades, etc. The frame is die-cast and the bearings are an integral part of the casting. The motor is nickel-plated and the cast base finished in rich velvet black. It is equipped with cord and plug with rheostat for governing speed. The rheostat has a special lock so that any desired speed may be obtained.

Lighting Unit

The Reflectolyte Company, 914 Pine Street, St. Louis, Mo., is offering to the trade the lighting unit shown herewith, known as the "Ceiling-Bright Reflectolyte."

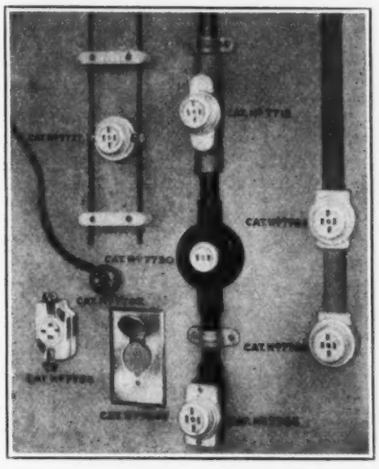
It consists of a bell-shaped glass diffusing shade, topped with perforated metal cap, which is held firmly in place in the middle of the reflector's base by three small clips. It is pointed out that the light passes through the glass diffusing shade, softly illuminating the ceiling. As in standard types, the reflector is of heavy steel with white depolished porcelain enamel fused on layer by layer. The reflector can be detached from chains in a moment by means of a patented device and removed to facilitate cleaning. Being metal throughout, the reflector is breakproof.



CROSS-SECTION VIEW OF UNIT

Standard Receptacles

The recent additions to the line of "Standard" receptacles made by the Cutler-Hammer Manufacturing Company of Milwaukee, Wis., were designed, the manufacturer states, with the idea of providing a "standard" receptacle for the more popular forms of conduit fittings, as well as for metal molding and for cleat work. The illustration shows how easily these receptacles can be used with the various fittings. Receptacle No. 7753 is intended for use with flush plates having a hinged lid. Nos. 7760 (one-way base) and 7763 (two-way base) are for metal molding. Receptacle No. 7730 can be used in a condulet as shown or with round uni-



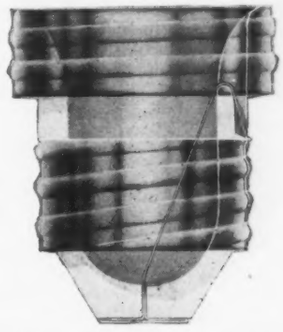
RIVETED CONSTRUCTION PREVENTS LOOSENING OF CLIPS

lets or any outlet box having sufficient depth and suitable cover. No. 7766 fits both ½-in. and ¾-in. (12.7-mm. and 19.1-mm.) Paiste taplets, and No. 7713 is for ½-in. (12.7-mm.) Obround condulets.

The receptacle for cleat work No. 7727 has proved very popular where open wiring is permitted. It can be readily slipped under the conductors supported by cleats and provides an additional outlet for any appliance. These receptacles are of two-piece construction held together with one screw and nut. Besides being small and neat in appearance, liberal provision has been made for entrance of the wires, and they are very easily wired. Riveted construction is used to mount the contact clips, thus insuring against loosening, as often happens when screws are used. The "standard" straight pull attaching cap shown in the illustration is interchangeable on all "standard" plugs and similar "standard" caps and receptacles of six other manufacturers. This interchangeability is very desirable in the factory or home where electrically operated devices equipped with various attaching caps are many times connected to plugs and receptacles furnished by several different manufacturers.

Refillable Fuse Plug

The accompanying illustration shows a refillable fuse plug manufactured by the Clemens Electrical Corporation of



REFILLABLE FUSE PLUG HAVING FEW PARTS

Buffalo, N. Y. The plug consists of three parts and the fuse element. To renew the fuse, the two brass rings are unscrewed from the porcelain holder, the blown fuse element slipped out and a new one placed in position. By screwing the rings back the fuse element is held firmly in place.

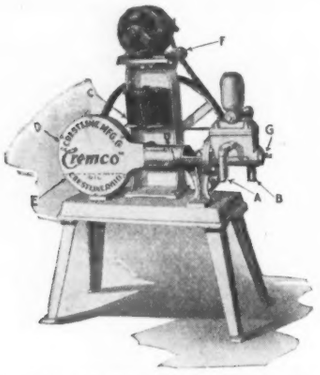
Vacuum Cleaner

Next to effective removal of dirt from carpets, rugs, etc., the most important point about a vacuum cleaner is its durability. For this reason the turbine principle has been most generally adopted by manufacturers, the typical machine having but one moving unit—an armature upon whose shaft extension is mounted the turbine rotor, the end of the shaft being housed in the bearing. Thus there are no gears, valves, bellows or diaphragms to require maintenance on the part of the user or the central station.

These principles are used in the "Vacuna" cleaner, manufactured by the Kent Vacuum Cleaner Company, Inc., of Rome, N. Y. The turbine used insures a constant flow of air, thereby maintaining the suction pressure at practically the same value whether the opening of the cleaning tube is closed by contact with the surface to be cleaned or whether it is free. The turbine operates at very high speed, and is carefully balanced so as to run steadily without vibration. Westinghouse alternating-current universal motors are used. This motor is designed on the principle used in the manufacture of very large motors, such as those used in railway work, and is of the concentric compensating type which insures very long brush and commutator life. Variation of speed at the same load between direct-current and alternating-current service is very small.

Electric House Pump Automatically Controlled

A small electrically driven pump for supplying rain water to residences is shown in the accompanying illustration. It may also be used for a general water supply where city service is



PUMP AND MOTOR MOUNTED ON SAME BASE

not available. The pump and motor are mounted on a cast-iron base and are connected by a belt. The pump is a slow-speed type. An automatic controller switch is connected with the discharge pipe and is set to operate between pressures of 20 lb. (1.4 kg. per sq. cm.) and 40 lb. (2.8 kg. per sq. cm.). It can be adjusted, however, to operate between any pressures that may be predetermined.

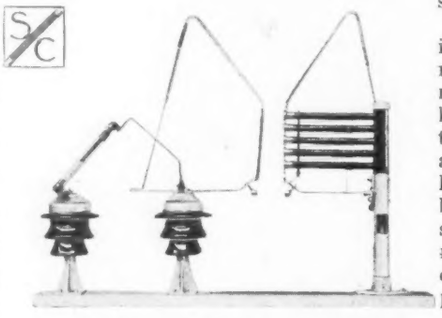
The pump is manufactured by the Crestline Manufacturing Company, Crestline, Ohio, and is equipped with a Robbins & Myers motor. The outfit is made in two capacities—125 gal. per hour and 250 gal. per hour, and in both sizes it will operate against a head of 50 lb. per square inch (3.5 kg. per sq. cm.).

High - Speed Sphere - Gap Graded-Resistance Lightning Arresters

The accompanying illustration shows a new type of high-speed sphere-gap graded-resistance lightning arrester manufactured by Schweitzer & Conrad, Inc., Chicago. Lightning arresters, it is pointed out, to be effective in protecting electrical apparatus must offer instantaneous relief from abnormal voltages and at the same time prevent the flow of excessive dynamic or generating current after the abnormal potential has been dissipated. The gap shown is the smallest at the upper end of the converging portion of the horns, where the maximum resistance is inserted. At the lowest or "no resistance" step the gap is of considerably greater extent.

The manufacturers claim that this arrangement has several important advantages. With any potential rise on the system protected by the arrester, the arc will start across the smallest gap with all of the resistance in series. If the power represented by the discharge is small, the current flowing through this gap and comparatively high resistance may be sufficient to keep the line voltage down approximately to normal. If the current flowing through the gap of maximum resistance is not sufficient to keep the line voltage down, the arc will break across the next lower step and a larger current will flow across this gap. If this current is still insufficient to keep the voltage at a safe value, then the next lower step will arc across, and so on, until the "no resistance" or lowest step is reached, when a practically unlimited electric current is allowed to flow to ground.

When the particular step is reached where sufficient current will flow to dissipate the potential rise, the voltage will be reduced to its normal value, and the arc will then tend to rise along the converging part of the horn, being driven upward both by the heated air and by the electromagnetic effect. As the arc rises along the converging part of the horn the dynamic or generator current is cut down in value as the resistance in circuit is increased step



BAKELITE TUBES PROTECT RESISTANCE FROM EFFECTS OF WEATHER

by step until the diverging portions of the horns are reached, where it will rise and lengthen until the arc breaks. The resistance units are inclosed in high-grade Bakelite tubes which protect them effectively against the weather, so that the arrester can be used outdoors without any protecting coverings. By loosening two bolts of a clamp on the top of the porcelain insulator cap the live horn can be adjusted to meet any condition.

Portable X-Ray Set for Field Service

During 1917 the research laboratory of the General Electric Company made some experiments and developments in X-ray apparatus of interest to the medical and surgical professions. The concrete result of these efforts was a portable X-ray outfit, in order that troops in active service at a distance from base hospitals might have the benefits of X-ray examination promptly available. This was accomplished by a process of elimination through a series of tests which resulted in the final assembly of the most suitable products of several manufacturers which are used in connection with the Coolidge tube. Particular care was taken to pick out those elements which were in actual production and available for immediate use.

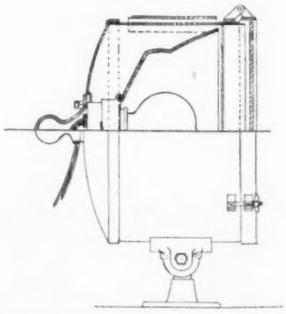
The equipment consists of a single-cylinder, air-cooled gasoline engine direct-connected to a 1-kw. direct-current generator provided with slip-rings, a main X-ray transformer, a filament transformer for lighting the filament of the Coolidge tube, a voltmeter and milliammeter, the necessary controls and switches and a special radiator type of Coolidge tube capable of rectifying its own current. Variation of X-ray output is obtained by variations of engine speed. The carburetor of the engine is controlled through a solenoid, and the necessary changes in speed are effected by means of a simple resistance unit installed at the head of the operating table when the outfit is in process of utilization.

For radiographic work the set will deliver 10 milliammeters at a voltage corresponding to a spark of 5 in. (12.7 cm.) between points. For fluoroscopic work the current is reduced to 5 milliammeters, the voltage remaining the same.

Owing to the rectification characteristics of the Coolidge tube no separate rectifier is required. The entire equipment, including the operation table, can be readily assembled or disassembled for transportation, the complete set having a net weight of about 860 lb. (390.1 kg.) While sets for similar service have been developed in Europe under the spur of urgent need, the equipment here referred to constitutes the first American portable X-ray outfit of this capacity to be manufactured.

Projector for Floodlighting

A powerful floodlight projector especially adapted to protective night lighting has recently been placed upon the



CROSS-SECTIONAL VIEW OF REFLECTOR FOR FLOODLAMP

market by the National X-Ray Reflector Company of Chicago. The projector ordinarily uses a 400-watt gas-filled flood-lighting lamp. The socket is adjustable and can be controlled from the outside so that the beam of light can be varied from a 12-deg. to a 30-deg. angle. A swiveling and tilting device at the base plate make the projector flexible in operation.

Trade Notes

THE ALBERT EMANUEL COMPANY, public utility operator, 710 Schwind Building, Dayton, Ohio, has moved its offices to No. 61 Broadway, Room 712, New York City.

W. F. GEORGES, formerly of the Western Electric Company of Cincinnati and New York, has joined the selling organization of the Trumbull Electric Manufacturing Company, with headquarters at the New York office, 114 Liberty Street.

J. G. SANDIDGE, who has been in the Chicago office of the Cooper Hewitt Electric Company of Hoboken, N. J., as district salesman for the last few years, is now at 1011 Majestic Building, Milwaukee, Wis., and will look after Cooper Hewitt matters in that vicinity.

CYRUS SCHUMACHER of Bluffton, Ohio, announces that he is going to manufacture air motors to be used in charging storage batteries for farm lighting and especially for irrigating purposes. Mr. Schumacher recently severed his connection as superintendent of the Bluffton Light & Water Works.

CHARLES G. ROBIN, INC., 48 Warren Street, New York City, announces its purchase of the Indesco Lighting Fixture Company at 47 Warren Street. The entire electrical stock of the former concern will be moved to the latter address at once, where a complete line of electrical supplies and fixtures will be carried.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY announces that its Pittsburgh service department has moved from its former location on Amberson Avenue to new quarters at 6905 Susquehanna Street, in the Homewood district of Pittsburgh. Express and freight should be consigned to East Liberty, Pa., via the Pennsylvania Railroad. The automobile equipment service department has also moved to the new location.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY of East Pittsburgh, Pa., has recently secured the exclusive sales agency for the United States for Frankel solderless connectors. Manufacturing facilities have been increased by the Frankel Connector Company in order to care for the new business to be secured through the Westinghouse sales organization. The Westinghouse company will act also as a distributer of Frankel testing clips.

THE MANHATTAN ELECTRICAL SUPPLY COMPANY of Boston, Mass., at the annual meeting, elected Burtis H. Ellis first vice-president and treasurer, James Ryan second vice-president, N. F. Johnson second vice-president and assistant treasurer, Edgar Whitmore secretary, Rufus Wilbur, Courtnay Guilds and Frank Pierce directors. A statement of earnings which is expected in a few days will, it is estimated, show profits after taxes applicable to dividends of nearly $600,000.

WILLIAM T. PRICE resigned as manager and chief engineer of the De La Vergne Machine Company, oil engine department, recently, to become president of the P-R Engine Company of New York and second vice-president of the Rathbun-Jones Engineering Company of Toledo, Ohio, which will undertake the sale and manufacture respectively of Price-Rathbun stationary and marine oil engines built in accordance with a new principle of fuel injection developed by Mr. Price in the last few years. The P-R Engine Company has its main office at 110 West Fortieth Street, New York, and other offices in Philadelphia, Baltimore and Toledo.

THE FEDERAL SIGN SYSTEM (ELECTRIC), Chicago, the building of which was the scene of a severe fire last week, reports that it has entirely recovered from this unfortunate accident. The fire was discovered at 5.40 o'clock in the evening of March 13, and defied the firemen until 10 o'clock. The rooms which were wrecked were the tin shop, the machine shop and an auxiliary stock room used for storage of excess material. While the office suffered considerable damage from water, no records were lost. The office staff was doing business as usual in an adjacent building at 10 o'clock on the following morning. The company's sign, fuse, washing-machine and vacuum-cleaner departments were not damaged. While the loss occasioned was of the magnitude of $200,000, it was fully covered by insurance. H. I. Markham, general manager of the company, stated that it was particularly fortunate that the fire broke out where it did rather than in some other location, since the departments destroyed were those in which work is now most slack and can be most easily maintained by transferring activities to outside shops. Space to take care of this work in an adjacent building has already been arranged for. The fire, it is stated, will not have any adverse effect on deliveries of goods to the company's customers.

CAPTAIN RICHARD P. HENRY, late of the United States Army, has joined the selling forces of the Square D Company of Detroit, manufacturer of steel inclosed safety switches, and has been appointed to the Indiana territory, with headquarters at Indianapolis. He spent three years at Purdue University, since when he has been engaged in various branches of engineering work. His first position was that of assistant engineer for the Terre Haute, Indianapolis & Eastern Traction Company, Terre Haute Division. In 1912 Captain Henry joined the Santa Susana Syndicate, Los Angeles, Cal., in the capacity of engineer and assistant geologist, and later entered the contracting business for himself, with offices at Chicago. He finally enlisted in the Engineering Corps of the United States Army, from which he was recently given an indefinite leave of absence on account of physical disability.

Trade Publications

FANS.—Marelli fans for the 1918 season are illustrated and described in a circular prepared by H. Boker & Company, Inc., 101 Duane Street, New York City.

ARTIFICIAL LOAD.—The Western Electro Mechanical Company of Oakland, Cal., has issued a circular describing its "phantom load" for testing alternating-current wattmeters.

MOTOR NECESSITIES. — The Emil Grossman Manufacturing Corporation of Brooklyn, N. Y., is distributing its catalog No. 10, descriptive of its "Ever Good" motor necessities.

ELECTRIC LANTERN.—The Lindstrom, Smith Company of Chicago has issued a one-leaf circular illustrating its White Cross Electric Lantern and showing the uses to which it can be put.

ILLUMINATING GLASSWARE. — The Tarentum Glass Company of Tarentum, Pa., has issued a thirty-two-page catalog illustrating and describing its Tara glass products for direct and indirect illumination.

CABLE CLAMPS.—W. N. Matthews & Brother, Inc., St. Louis, Mo., has issued a one-page circular entitled "Labor Conservation." The circular explains the use and shows illustrations of the Matthews wire and cable clamps.

GENERATING SETS.—The Universal Motor Company of Oshkosh, Wis., has prepared bulletin No. 26, showing its 4-kw. generating sets. Photographs showing the various uses to which the generator sets may be put are printed.

EXPANSION JOINTS.—A circular on the Nuttall one-piece expansion joint which is being distributed by Nuttall of Pittsburgh, Pa., refers to an expansion joint which requires no packing and eliminates loops and bends in the pipe lines.

REFRIGERATING MACHINERY.—Bulletin No. 17 of the De La Vergne Machine Company of New York City shows actual installations of the De La Vergne ammonia condensers. The bulletin shows both the counter-current and parallel-flow types.

OIL FUSE CUT-OUTS.—The D. & W. Fuse Company of Providence, R. I., has recently issued a well-illustrated catalog showing the different types of fuse cut-outs which it manufactures. The booklet contains the rating of the different fuses and also a price list. Several actual installations are shown.

LIGHTING FIXTURE.—The Beardslee Chandelier Manufacturing Company of 216 South Jefferson Street, Chicago, has prepared a full-page circular showing the construction and method of support of its "Quick-Action" ceiling ring. Several sizes of ceiling rings are shown, together with various styles of glassware.

REFLECTOLYTE.—This is the name of catalog No. 4 issued by the Reflectolyte Company, 914 Pine Street, St. Louis, Mo. The bulletin is well illustrated and shows a number of semi-indirect lighting units made by the company. The illuminating requirements of public, private and industrial institutions are well outlined.

MODERN METHODS IN TEXTILE MILLS.—Under this name the Westinghouse Lamp Company, 165 Broadway, New York City, has issued a publication showing the need of better lighting in textile mills. It gives pictures comparing the effect of illlighted mills and well-lighted mills. The booklet is bound with a substantial cloth cover.

AUTOMATIC SKIP HOIST.—The Otis Elevator Company, Eleventh Avenue and Twenty-sixth Street, New York, has issued a bulletin referring to its skip hoists, which are automatically operated. Different types of skip hoists, their layout, and some typical installations in manufacturing plants, coal and coke plants, gas, electric light and power stations are shown.

SINGLE-PHASE MOTORS.—The Century Electric Company of St. Louis, Mo., has issued a catalog of its single-phase self-starting motors which are rated at 0.1 hp. to 30 hp. and which are of the repulsion-start induction type. Cross-section views of several types of motors are shown in the booklet. Actual installations and applications of the single-phase motors are also shown.

CIRCUIT BREAKERS.—The Automatic Reclosing Circuit Breaker Company of Columbus, Ohio, has recently issued bulletin No. 30, entitled "Automatic Reclosing Circuit Breakers and Relays for the Protection of Direct-Current Circuits." The bulletin gives a general description of the principle and applications of the circuit breakers and shows actual installations in several mines. It is well illustrated and contains several wiring diagrams of the apparatus.

PUMPS.—The C. H. Wheeler Manufacturing Company, Eighteenth Street and Lehigh Avenue, Philadelphia, is distributing a booklet entitled the "Radojet Air Pump." The bulletin is well illustrated, giving the outside views of various size injector-type pumps and showing the application of the so-called air "pump" in a power plant. The general arrangement of the piping system for air removal from condenser, etc., is also shown. Steam tables are included.

FARMERS' ELECTRICAL HANDBOOK. —This is the title of a valuable book published by the Western Electric Company on the application of electricity to farm service. Besides being a complete catalog of the apparatus and appliances used for farm lighting, the booklet shows how to wire a house and how to start telephone companies in rural districts. The book mentioned is the fourth edition of the "Farmers' Electrical Handbook," the previous editions being issued in 1916 and 1917.

New Incorporations

THE SUPREME ELECTRICAL CONSTRUCTION COMPANY of Brooklyn, N. Y., has been incorporated with a capital stock of $5,000 by E. B. Cohen, H. Rothenberg and H. Bertinger, 135 Broadway, New York, N. Y.

THE HARTWELL - RADEMAEKERS MANUFACTURING COMPANY of Newark, N. J., has been incorporated by William H. Rademaekers and Albert E. Hartwell of Newark. The company is capitalized at $150,000 and proposes to manufacture electric motors.

THE MERRILL MANUFACTURING COMPANY of Boston, Mass., has been chartered with a capital stock of $50,000 to manufacture spark plugs and mechanical and electrical appliances. William J. Russell is president and Thomas B. Sweeny, 50 State Street, is treasurer.

THE STANLEY ENGINEERING COMPANY has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $4,000,000 for the purpose of installing steam, electric and hydraulic plants, etc. The incorporators are: C. L. Rimlinger, M. M. Clancy and F. A. Armstrong of Wilmington, Del.

THE VICTORIA SALES CORPORATION of New York, N. Y., has been incorporated by A. Ornstein, 1838 Seventh Avenue, New York City; P. A. Larter, Bensonhurst, N. Y., and F. A. Schilling, 647 Academy Street, New York, N. Y. The company is capitalized at $30,000 and proposes to manufacture electric lamps for automobiles, etc.

THE CINCINNATI SPECIALTY MANUFACTURING COMPANY of Cincinnati, Ohio, has been incorporated with a capital stock of $25,000 by J. E. Snyder, S. S. Oakley and others. The company formerly operated a plant at Powers Street and Sylvan Avenue under a partnership. One of the specialties manufactured by the company is an automatic extension reel for electric lamps.

New England States

BURLINGTON, VT.—The Electric Light Commissioners are considering the question of renewing the contract with the Burlington Light & Power Company for furnishing hydroelectric power for the municipal electric-light plant, which expires April 1.

CAMBRIDGE, MASS.—Plans have been completed and bids taken by the Cambridge Electric Light Company, 46 Blackstone Street, for the construction of and addition to its power plant, about 30 ft. by 50 ft., one story high.

EAST HAMPTON, MASS.—Work has begun on the construction of a new power plant and switchroom at the works of the Glendale Elastic Fabrics Company, to cost about $10,000. Contract has been awarded to the Casper Range Construction Company, 29 Bond Street, Holyoke.

WORCESTER, MASS.—Plans are being prepared by the W. H. Sawyer Lumber Company, 66 Lincoln Street, for the construction of a power house in connection with its proposed new plant. The cost of the work is estimated at $70,000.

FORESTVILLE, CONN. — The power plant of the Peck & Young Manufacturing Company was completely destroyed by fire on March 10.

TERRYVILLE, CONN.—At the annual town meeting is was voted to change the street lighting system from arc lamps to incandescent.

Middle Atlantic States

BINGHAMTON, N. Y.—Contracts have been awarded by the Binghamton Light, Heat & Power Company for furnishing energy to the amount of 300 hp. to two large manufacturing plants, due to the destruction of a portion of a dam in the Susquehanna River rendering useless the water-power plants of the two companies.

BUFFALO, N. Y.—Plans have been prepared by the National Aniline & Chemical Company for the construction of an addition to its power house, to cost about $8,000.

BUFFALO, N. Y.—Bonds to the amount of $60,000 have been authorized by the City Council to provide funds for the proposed improvements in the police and fire-alarm systems, including the installation of underground conduits to replace overhead wires.

LOCKPORT, N. Y.—Notice has been filed by the Lockport Light, Heat & Power Company with the Public Service Commission of an increase in capital stock from $150,000 to $350,000, the proceeds to be used for extensions, etc., to its system.

NEW HAMPTON, N. Y.—The contract for the construction of a new power house at the local reformatory for the Department of Correction, Municipal Building, New York, has been awarded to Nelson & Miller, West Main Street, Middletown.

NEW YORK, N. Y.—Plans are under consideration by the New York Telephone Company, 15 Dey Street, for building an addition to its telephone exchange building at West New Brighton.

NEW YORK, N. Y.—The National Lead Company has awarded a contract to Charles E. Knox, 101 Park Avenue, New York, for electrical work in connection with its new six-story factory building, to be erected at Marshall and Gold Streets, Brooklyn.

NIAGARA FALLS, N. Y.—Contract has been awarded by the National Carbon Company to the Osborn Engineering Company of Cleveland, for erection of additional factory buildings at its plant in Niagara Falls, including a six-story building, 54 ft. by 193 ft., a two-story 20 ft. by 114 ft., and two one-story buildings, 70 ft. by 144 ft. and 49 ft. by 70 ft., to cost about $200,000.

JERSEY CITY, N. J.—Bids will be received by the Boulevard Commission until April 3 for furnishing new lamps, generators and other appliances for use in connection with the proposed improvements to the electric-lighting system on the Boulevard.

NETCONG, N. J.—Plans are being considered by the Council for the installation of a new ornamental lighting system on Main Street. Lamps of larger candlepower will be installed.

NEWARK, N. J.—A permit has been taken out by Maas & Waldstein, Inc., Avenue R, for the construction of an addition to its plant and for improvements to boiler house. The cost of the entire work is estimated at $12,000.

TRENTON, N. J.—Plans for the construction of a new municipal hydroelectric power plant, to be located on Sanhican Creek, is under consideration by the City Council.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

DELAWARE WATER GAP, PA. — The Pennsylvania Utilities Company of Easton has applied to the Borough Council for a franchise to furnish electricity for lamps, heaters and motors in Delaware Water Gap for a period of 15 years. Application was also made to the Council for permission to tie in the 2300-volt transmission line of the utilities company, which extension was made from the Analomink Paper Company about a year ago.

ERIE, PA. — The Council has appropriated $4,756 for the construction of a conduit for low and high tension wires through the Parade Street subway, extending from Fourteenth to Seventeenth Street.

NANTICOKE, PA.—Contract has been awarded by the board of managers of the State Hospital to John Curtis & Company, 1 Hickory Street, Wilkes-Barre, for the construction of a new power house, about 50 ft. by 65 ft., one story high.

PHILADELPHIA, PA. — Contract has been awarded by Andrew J. Sauer & Company, architects, to the Coneen Construction Company for a one-story power house to be erected at 2626 Martha Street, for M. A. Lieberman.

STEELTON, PA.—Plans are being considered by the Bethlehem Steel Company for the installation of four new boilers of 250 hp. each in the new addition now under construction at its works near Swatara Street.

TOPTON, PA. — The Bowers Electric Company has petitioned the Public Service Commission for approval of a franchise granted by the borough of Topton to supply electrical service in the borough.

TYRONE, PA.—The West Virginia Pulp & Paper Company has awarded a contract to John G. Livingston, Jr., 70 East Forty-fifth Street, New York, for electrical work in connection with the construction of its new manufacturing plant, consisting of eight large buildings, under construction at Tyrone, at a cost of about $500,000.

BOWERS, DEL.—Steps have been taken to organize a company to install and operate an electric-light plant in Bowers. W. E. Kelly is reported interested in the project.

BALTIMORE, MD.—Preparations are being made by the Consolidated Gas, Electric Light & Power Company for the erection of a branch power station in Linthicum, 40 ft. by 26 ft., to cost about $7,000, for which bids have been submitted.

ELLICOTT CITY, MD.—A bill has been introduced in State Legislature authorizing the Commissioners of Ellicott City to issue bonds for the installation of a municipal electric-light plant, providing a majority of taxpayers ask for same.

BLUEFIELD, W. VA.—Plans are being considered by the City Council for improvements to the street-lighting system. It is proposed to discard the arc lamps now in use and install incandescent street lamps.

NEWPORT NEWS, VA.—Plans are under consideration by the Chesapeake & Potomac Telephone Company for the erection of a new telephone exchange plant. P. G. Burton, 108 East Lexington Street, Baltimore, Md., is engineer.

WASHINGTON, D. C. — The Potomac Electric Company is planning to build a boiler house on Benning Road, to cost about $75,000.

WASHINGTON, D. C.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., has awarded contract to the General Electric Engineering Company, 317 Canal Street, New York, N. Y., to install an electric-light and power system at the navy yard at Anacostia, D. C., to cost $10,539.

WASHINGTON, D. C. — Contract has been awarded by the United States Food Administration to the George A. Fuller Company, Munsey Building, Washington, D. C., to erect an office building at Twentieth and D Streets, N. W., two stories, 155 ft. by 334 ft., with five courts, 2 ft. by 105 ft., to cost about $150,000.

WASHINGTON, D. C.—Bids will be received at the office of the purchasing agent of the Post Office Department, Washington, D. C., until April 9, for furnishing electrical supplies (motors, carbons, fuses, etc.). Blanks for proposals with specifications may be obtained upon application to the purchasing agent.

WASHINGTON, D. C.—Bids will be received at the office of the Commissioners of the District of Columbia, Washington, D. C., until April 2, for furnishing and delivering during the fiscal year beginning July 1, 1918, and ending June 30, 1919, for use of the various branches of the government of the District of Columbia supplies as follows: Electrical supplies, chemicals, laboratory supplies, etc. Form of proposal, specifications and necessary information may be obtained from the purchasing officer of the District of Columbia, Room 320, District Building, Washington, D. C.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Brooklyn, N. Y., Schedule 1725—134,000 ft. leaded and armored, plain interior-communication cable, 870,000 ft. leaded and armored, plain, duplex double-conductor wire, 140,000 ft. armored, duplex double-conductor wire, 260,000 ft. plain single-conductor wire, 158,000 ft. soft steel, leaded and armored, single-conductor wire; Schedule 1724—400,000 ft. twin lamp cord, 50,700 ft. lead-covered wire, 202,500 ft. duplex rubber-covered wire, 37,000 lb. weather-proof wire on reels. Philadelphia, Pa., Schedule 1725 — miscellaneous plain enameled magnet wire. Application for proposal blanks should designate the schedule desired by number.

North Central States

MARQUETTE, MICH.—Plans are being prepared by the Arnold Company, 105 South La Salle Street, Chicago, Ill., for the construction of a plant, consisting of 10 buildings for the Lake Superior & Ishpeming Railroad Company, to cost about $400,000. Bids, it is understood, are now being received by the architects for construction of the buildings.

NORTHPORT, MICH.—Plans, it is reported, have been completed by the Electric Point Mining Company for the installation of an aerial tramway, connecting the shaft with the wagon road at Leadpoint, a distance of 2¼ miles. It will have a capacity of 20 tons an hour and will cost from $40,000 to $50,000.

PORT HURON, MICH.—The City Commission is considering a proposal for the installation of electrically operated pumps to replace the steam pumps at the water-works station. The cost is put at $19,000.

READING, MICH.—The Council is considering submitting the proposal to issue $8,000 in bonds for improvements to the water and light systems to the voters.

CARTHAGE, OHIO.—Contract has been awarded by the Polak Steel Company of Cincinnati to the M. Marcus Building Company of Cincinnati for the construction of an addition to its power plant at Carthage.

CLEVELAND, OHIO.—Bids will be received at the office of the commissioner of purchases and supplies, City Hall, Cleveland, until March 29, for valves for the division of light and heat. Specifications may be obtained at the office of the division of light and heat.

CLEVELAND, OHIO. — The Cleveland Electric Illuminating Company has awarded contract for construction of a one and two-story reinforced concrete steel and brick power house, 150 ft. by 200 ft., to be erected on East Seventieth Street, to the National Concrete Fireproofing Company, Citizens' Building. The cost is estimated at about $1,000,000.

HAZARD, KY.—The Perry Coal & Lumber Company is contemplating the installation of an electrically-operated plant for a coal development on the Louisville & Nashville Railroad in Perry County. Frank Nudleman and others of New York, N. Y., are reported interested in the project.

ATTICA, IND.—The municipal electric-light and water works plant was destroyed by fire on March 9, causing a loss of about $60,000. At present the city is without electrical service and the water supply is inadequate. Steps have been taken to rebuild the plant and $100,000, or as much as needed, was pledged by the business men.

BIGGSVILLE, ILL. — The Biggsville Light Company is contemplating changing its system to alternating current, single phase, and extending its service to two small towns and farmers along the line, which will require about a 75-kva., single-phase, 2200 or 1100-volt machine. D. W. Lee is vice-president.

CHARLESTON, ILL. — Bonds to the amount of $20,000, the proceeds to be used for improvements to the municipal electric-light plant and water-works system, have been authorized.

CHICAGO, ILL. — The Drainage Board has decided upon an expenditure of $50,000 for rehabilitating the electrical system. The report of the engineers estimated the cost of the work at $200,000.

CHICAGO, ILL.—The War Department is planning to erect several large warehouses in Chicago for army supplies. Contract has been awarded to the E. W. Sproul Company, 1129 West Thirty-fifth Street, for the erection of a six-story, 500 ft. by 600 ft., army distributing warehouse, with a ten-story tower and one-story power house, at Thirty-ninth Street and Ashland Avenue. Two units are to be built at once at a cost of about $2,800,000. Work has begun on the above buildings. George C. Nimmons, 122 South Michigan Avenue, will have charge as supervising architect for the government.

MOUNT OLIVE, ILL.—At an election to be held April 16 the proposal to issue $8,000 in bonds for improvements to the municipal electric-light plant will be submitted to the voters. It is proposed to equip the waterworks pumping station with electrically-operated pumps. W. S. Merkle of St. Louis, Mo., is engineer in charge of the proposed improvement.

SIDNEY, ILL.—The Village Board has accepted the proposal of the Homer (Ill.) Electric Light Company to supply electrical service in Sidney for one month. If the service is satisfactory the local plant will be closed down and energy will be supplied from the Homer system.

CLINTONVILLE, WIS. — Work has started on the construction of a hydroelectric power plant on the Embarrass River, about 12 miles north of the city, for the Topp-Stewart Tractor Company of Clintonville. The plans provide for an initial installation of 750 hp. Electricity generated at the plant will be transmitted to the new tractor factory in Clintonville.

GREEN BAY, WIS. — Contracts have been awarded by the Northwest Engineering Works of Green Bay for the construction of a new fabricating shop, 30 ft. by 120 ft., and an addition to the boiler shop, 50 ft. by 150 ft. Two floors of an adjoining building will be remodeled into mold lofts. Considerable equipment is being purchased by the company, including a 10-ton jib crane, two furnaces and an electric air compressor. The company has contracts for construction of several steel ships.

MILWAUKEE, WIS.—Bids, it is understood, will soon be called for by the Board of Directors for the construction of a new high school building to cost about $450,000, including manual training and domestic science departments. Frank M. Harbach is secretary.

WAUSAU, WIS.—Bids, it is expected, will soon be asked by the board of education for the construction of the first unit of the proposed new industrial and vocational training institute, to cost about $250,000. The first building will be 90 ft. by 200 ft.

BOYDEN, IOWA. — Veenschoten Brothers, owners of the local electric-lighting system, are erecting an electric transmission line to Sheldon, where they will purchase electricity from the Iowa Light & Power Company. Energy will be transmitted at 6600 volts, 60-cycle, single-phase and stepped down to 100 volts at Boyden. The local system will be changed from direct to alternating current. It is expected to have the line completed about April 1.

OSSIAN, IOWA.—The local electric-light and power plant, owned by Harry Bullard, has been purchased by A. G. O'Rear of Mason City. The new owner, it is understood, will make improvements to the system.

PALMER, NEB.—The local electric-light plant was recently destroyed by fire.

CHAPMAN, KAN.—Work will begin on the construction of the new transformer station of the United Telephone Company. A number of important improvements, it is understood, will be made by the company this spring.

MORAN, KAN. — The Municipal Light and Water Department is considering the question of supplying electricity in Bronson for domestic and power purposes. If the project goes through a 100-hp. oil engine will be required in addition to the present equipment, to be installed within three to six months. Correspondence is solicited from parties who have a second-hand 60-cycle, three-phase, 2300-volt alternator of 75 kvā. capacity to sell. R. S. Parsons is general superintendent.

OAKLEY, KAN. — The erection of an electric transmission line from the municipal electric-light plant to Colby is under consideration by the city of Oakley to secure electricity to operate the local system.

PITTSBURG, KAN. — Bids will be received by the Sisters of St. Joseph, care of G. W. Van Meter, Caldwell-Murdock Building, Wichita, until March 27 (extension of date) for construction of addition to Mount Carmel Hospital, two and three stories and basement, 50 ft. by 136 ft. Separate bids to be submitted on heating, electric wiring, plumbing, elevator and vacuum cleaner, etc. The cost is estimated at $100,000.

YATES CENTER, KAN.—The municipal electric-light plant was wrecked by a tornado on Feb. 28.

Southern States

SOUTHPORT, N. C. — The property of the Southport Electric Light & Power Company is reported to have been purchased by J. G. White & Company, 43 Exchange Place, New York, N. Y., for $50,000. Improvements, it is understood, will be made to the system, involving an expenditure of about $20,000, and will include the installation of a 20-ton ice plant.

ATLANTA, GA. — The Board of Water Commissioners has rejected the bid of the Georgia Railway & Power Company to furnish electricity for a proposed new pumping plant, at an annual charge of $58,000. The Council has appropriated $34,500 for the construction of a pump having a capacity of 15,000,000 gal. per day.

ATLANTA, GA. — The Department of Justice has asked for an appropriation of $1,000,000 for the installation of 500 light and medium weight looms, 1050-hp. electric motor drive, etc., for weekly capacity of 116,000 lb. of cotton duck. This machinery is to equip a 457-ft. by 210-ft. reinforced concrete brick construction weave mill, one story, constructed by prison labor, at a cost of $129,500, at the United States penitentiary. Lockwood, Greene Company of Atlanta, Ga., and Boston, Mass., are architects and engineers.

MACON, GA.—Contract has been awarded by the War Department, Cantonment Division, Washington, D. C., to W. Z. Williams, Georgia Casualty Building, Macon, for construction of the proposed hospital buildings at Camp Wheeler, to cost from $150,000 to $170,000.

ANNISTON, ALA. — The War Department, Washington, D. C., has awarded the Crowell Construction Company of Chicago, Ill., the contract for construction of buildings for hospital at Camp McClellan, to cost about $500,000.

BIRMINGHAM, ALA. — The Alabama Interurban Railway Company, which is planning to build an electric railway from Birmingham to Lock No. 17 on the Warrior River, a distance of about 20 miles, is also contemplating building branches, one to Patton Ferry, 5 miles long, and to Shoal Creek, 15 miles. Another extension to Lock No. 16 and Davis Creek is also under consideration.

LITTLE ROCK, ARK.—Bids will be received by the school board until March 28 for construction of a grade and junior high school building, to cost about $100,000. Separate bids to be submitted on wiring, plumbing and heating.

JENNINGS, LA. — An election will be called to submit the proposal to issue bonds for the installation of an electric-light plant, ice factory and sewer system to the voters.

PLEASANTON, TEX.—The Town Council has decided to take over the local electric plant for a period of 60 days to test municipal ownership. If it proves satisfactory the plant will be purchased by the city.

Pacific and Mountain States

CENTRALIA, WASH.—F. M. Lewis and others have organized a company for the purpose of manufacturing and using a propeller type current water motor, which will operate pumping machinery for placing water on desert land. The machine was patented by Mr. Lewis.

CHEHALIS, WASH.—The proposal to grant O. B. Anderson of Portland, Ore., a franchise to supply electricity for lamps and motors in Chehalis will be submitted to the voters at a special election to be held April 20. The Council recently refused to grant this franchise on the ground that it would result in a duplication of systems. Upon refusal of the Council a petition was circulated by the promoter, and sufficient signatures were secured to warrant placing the matter before the voters.

HOQUIAM, WASH.—The City Council has entered into a contract with the Grays Harbor Railway & Light Company of Aberdeen for lighting the streets of the city for a period of five years. Under the terms of the contract the company is to install and maintain 220 incandescent lamps of 80 cp. In relocating lamps or placing new lamps the city is to bear the expense of erecting poles and stringing wires.

POULSBO, WASH.—The Puget Sound Pulp & Paper Company has been granted a franchise to erect and operate an electric transmission line in Poulsbo for a period of 25 years.

SEATTLE, WASH.—Plans are being prepared by the Puget Sound Traction, Light & Power Company for the construction of coal bunkers for its coal-pulverizing plant, at 1316 Western Avenue, to cost about $17,000.

SEATTLE, WASH. — Plans have been submitted by A. H. Dimmock, city engineer, for the proposed elevated railroad to the shipyards. It is proposed to erect a timbered elevated roadway to extend from First Avenue South and Washington Street and West Watersit to Riverside, the shipyards and West Seattle.

SPOKANE, WASH. — The City Council has awarded the Washington Water Power Company a contract to install the new ornamental lighting system on Post Street from the east end of the Post Street bridge to the north side of Third Avenue, at $40,545. The contract includes maintenance of lamps and furnishing electricity for same for a period of 10 years.

TACOMA, WASH.—Plans are being prepared by the electrical department for the construction of a substation to supply electricity from the municipal electric plant to operate the municipal tideflats car line.

REEDSPORT, ORE.—The Umpqua Power Company, recently incorporated, will take over the plant of the Gardiner Light & Power Company of Gardiner. The plant will be removed to Reedsport, but electrical service will be furnished in Gardiner. It is understood that the Umpqua Power Company and the Coos & Curley Telephone Company will erect a joint pole line.

BOVILL, IDAHO.—The installation of a storage battery in the municipal electric-light plant this summer is under consideration; also a third wire to cut out the street lamps at will, by the City Council. J. L. Shampine is engineer of power station.

NAMPA, IDAHO.—The City Council has awarded the Idaho Power Company a new contract under the terms of which the present arc-lighting system will be replaced with incandescent tungsten lamps. One hundred lamps varying in candlepower from 100 to 400 will be installed. At present there are 61 arc lamps.

HELPER, UTAH.—Application has been filed with the state engineer by G. R. Corey of Salt Lake City for permission to use 125 second ft. of water from Price River to develop 1600 electrical horsepower. The proposed plant will be located within a few miles of Helper. The plans provide for the construction of a concrete dam, 3 ft. high and 40 ft. long, the water to be carried in a ditch for a distance of 1½ miles, passing through two 4-ft. wheels under an 85-ft. head.

YUMA ARIZ.—Several additions and extensions are contemplated to the municipal electric-light, power and water plant: (1) The erection of an electric transmission line, 6600 volts, south and one to the west of town, at present to supply ranches nearby, and to be extended as demanded until they reach some nearby towns; (2) to extend the present secondary network to supply every part of the town, which will need about 1½ miles of line. It is possible that demand for electrical service on these new lines will make it necessary to install a new unit in the power plant. Bids have been received on a 50-hp. unit. Several petitions for street lamps in various parts of the town which are as yet unlighted are under consideration by the Council. Fred Kuecke is superintendent.

JOPLIN, MONT.—Sufficient signatures have been placed on a petition to practically insure the erection of an electric transmission line by the Montana Power Company to supply electricity in Joplin and other towns in this district.

DES MOINES, N. M.—The Village Trustees have decided to call an election to submit the proposal to issue $50,000 in bonds to purchase the local electric-light plant and water works system and make extensions to same to the voters.

SANTA FE, N. M.—The first step has been taken by the City Council toward municipal ownership of the water and light plants. A committee has been appointed to place a valuation on the property of the company. The franchise of the Santa Fe Water & Light Company expires this year.

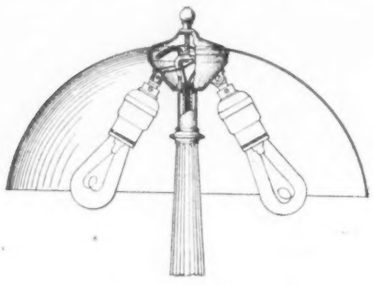
Canada

ARMAGH, ONT.—The Armagh Electric Company, it is reported, will ask for tenders for electrical equipment, to cost about $49,000.

(Issued Feb. 19, 1918.)

1,257,100. Electrical Fuse; John H. Naylor, Everett, Mass. App. filed Nov. 17, 1913. Cartridge type.

1,257,106. Electric Heating Device; Leon F. Parkhurst, Pittsfield, Mass. App. filed July 23, 1914. Applies particularly to such as are provided with a flat heating surface and may either be used independently as stoves or heaters or in conjunction with other heating apparatus.



1,257,496—Lamp Cluster

1,257,117. Automobile Signal; Frederick Rauscher, Port Richmond, N. Y. App. filed May 27, 1916. Operable to indicate when there is a change in the direction.

1,257,155. Ignition Device; Harry R. Van Deventer, Sumter, S. C. App. filed Feb. 15, 1916. For internal-combustion engine.

1,257,163. Electrical Battery-Charging System; Harry G. Webster, Chicago, Ill. App. filed April 18, 1912. Automobile.

1,257,177. Dynamo-Electric Machine; Sven R. Bergman, Nahant, Mass. App. filed Oct. 13, 1915. Relates especially to direct-current dynamo-electric machines adapted for operation as motors and as generators of practically constant direct-current electromotive force when operating at variable speed.

1,257,178. Dynamo-Electric Machine; Sven R. Bergman, Nahant, Mass. App. filed Oct. 18, 1915. Novel method of assembling parts of a dynamo-electric machine.

1,257,180. Impulse Transmitter for Automatic Telephone Systems; Gotthilf A. Betulander, Södertörns Villastad, Sweden. App. filed July 13, 1915. Consists in the use of a rotatable screw spindle for transmitting the rectilinear setting movement into a rotary movement.

1,257,193. Winding for Electric Motors; Neil Currie, Jr., Pittsfield, Mass. App. filed March 4, 1916. Improved winding.

1,257,246. Magnetic Shunt; Lloyd M. Kilgore, Pittsfield, Mass. App. filed Jan. 29, 1917. Each magnetic shunt is composed of a number of pieces of magnetic material, the number of which may be readily varied after the complete assembly of the transformer.

1,257,255. Electric Switch for Mines; Edward Leach, Rathmel, Pa. App. filed April 12, 1917. Automatic cut-out switch for use in connection with line and trolley wires.

1,257,272. Electric-Resistance Element; Guy M. Laird, Chicago, Ill. App. filed May 19, 1916. Composed of a metal which shall have the property of being particularly low in electric conductivity, have a melting point exceeding that of pure copper, and be capable of resisting oxidation at all temperatures and under all conditions to which it needs to be subjected, while at the same time possessing characteristics permitting it to be drawn or otherwise worked to form strips, strands or filaments.

1,257,283. Automatic Telephone System; Alfred H. Dyson, Chicago, Ill. App. filed Aug. 19, 1907. Novel arrangement of electrical connections between the switches whereby the chances of the calling line finding an idle trunk through which to extend its circuits are greatly increased.

1,257,287. Switch Device; William Kaisling, Chicago, Ill. App. filed June 5, 1914. Plurality of plungers are used, some of which are adapted for individual service and some of which are adpated for alternate service.

1,257,289. Meter Panel; Hubert F. Krantz, Brooklyn, N. Y. App. filed Dec. 18, 1912. Each busbar of panel can be connected to the same branch circuit.

1,257,294. Automobile Turning Signal; Henry Patrick, New Brunswick, N. J. App. filed March 23, 1917. Improvements.

Record of Electrical Patents

Notes on United States Patents

(Issued Feb. 26, 1918.)

14,436. (Reissue.) Process for the Electrolysis and Treatment of Sulphate Liquors. App. filed Aug. 18, 1914. Improved process.

1,257,303. Repeater System; John H. Bell, East Orange, N. J. App. filed May 16, 1916. Simplifies the arrangement of repeater circuits.

1,257,312. Alkaline-Battery Plate; Campbell C. Carpenter, Niagara Falls, N. Y. App. filed Oct. 18, 1912. Adapted to withstand the expansion and contraction during the repeated charge and discharge.

1,257,317. Telephone-Exchange System; Henry P. Clausen, Mount Vernon, N. Y. App. filed Oct. 12, 1915. Improvements in telephone trunk circuits.

1,257,336. Safety Device for Elevators; Alexander Gagnon, Biddeford, Me. App. filed Nov. 8, 1916. Means for automatically bringing the elevator car to a stop.

1,257,338. Line Switch; Charles L. Goodrum, New York, N. Y. App. filed Jan. 20, 1916. Relates to automatic telephone systems.

1,257,339. Flexible Electric Heater; Albert E. Grapp, Minneapolis, Minn. App. filed Dec. 20, 1915. Adapted for use for warming up various parts of an internal-combustion engine.

1,257,349. Control System; Rudolf E. Hullmund, Pittsburgh, Pa. App. filed Jan. 6, 1916. Single-phase commutator motor for starting a phase converter.

1,257,356. Aluminous Composition and Method of Preparing the Same; Otis Hutchins, Niagara Falls, N. Y. App. filed Nov. 14, 1917. Electric furnace process.

1,257,361. Telephone-Exchange System; Charles W. Keckler, Newark, N. J. App. filed April 24, 1917. Central-energy type; provides improved signaling means.

1,257,362. Telephone-Exchange System; Charles W. Keckler, Newark, N. J. App. filed April 24, 1917. Battery type; provides improved signaling means.

1,257,370. Telephone-Exchange System; Alben E. Lundell and Franklin A. Steers, New York, N. Y. App. filed Oct. 26, 1916. Operator is informed that a calling subscriber desires her attention.

1,257,375. Housing Electric Apparatus; Aldah R. Mecham, Oklahoma City, Okla. App. filed March 18, 1916. Moisture-tight.

1,257,381. Low-Frequency-Signal Repeater; Harold W. Nichols, Maplewood, N. J. App. filed Sept. 24, 1915. Amplifies and repeats low-frequency currents.

1,257,382. Indirect Illumination; Henry G. O'Neill and Ward E. Pearson, New York, N. Y. App. filed Oct. 30, 1916. Arrangement of indirect or reflected electric or other light rays with a mirror.

1,257,392. Telephone-Line-Selecting System; Frank N. Reeves and Alben E. Lundell, Newark, N. J. App. filed April 16, 1915. Improvements.

1,257,394. Terminal Bank; John N. Reynolds, Greenwich, Conn. App. filed Sept. 17, 1915. Inductive action prevented.

1,257,396. Process of Making Metallic Catalyzers; William D. Richardson, Chicago, Ill. App. filed Nov. 11, 1912. New method of preparing highly reactive catalysts.

1,257,412. Train-Dispatching System; Paul J. Simmen, Indianapolis, Ind. App. filed Nov. 18, 1911. Improved system.

1,257,418. Refillable Fuse; Basil L. Spurr and Frank A. Tittemore, Richmond, Cal. App. filed April 27, 1916. Fusible element of the proper capacity only may be installed.

1,257,426. Voltage-Regulating System for Vapor Rectifiers; William Tschudy, Wilkinsburg, and Sidney W. Farnsworth, Pittsburgh, Pa. App. filed Feb. 19, 1914. Means for regulating the voltage in the direct-current circuit.

1,257,440. Electrical Burglar Alarm; Alfred Zehden, Berlin, Germany. App. filed March 18, 1914. Resistance connected as branch of Wheatstone bridge.

1,257,451. Protection of Electric Cables; John H. Bowden, London, and Harry F. J. Thompson, Battersea Park, London, England. App. filed March 15, 1916. Protection of electric cables against leakage and faults in the insulation.

1,257,463. Switch; William D. Dean, Chicago, Ill. App. filed June 2, 1913. Simple and efficient arrangement of parts.

1,257,468. Internal-Combustion-Engine Testing Device; Roy G. Edgerton, Suffolk, Va. App. filed March 31, 1917. Readily applied to or removed from the cylinders.

1,257,496. Lamp Cluster; George L. Lamb, Nappanee, Ind. App. filed April 16, 1917. Adjustable lamp socket.

1,257,514. Electrical Measuring Instrument; William Meyer, Chicago, Ill. App. filed Aug. 23, 1915. Double-scale instrument.

1,257,516. Insulator Assemblage for Electrical Construction; Earle A. Muckey, San Francisco, Cal. App. filed Aug. 23, 1917. Universal detachable rigid connection.

1,257,526. Constant-Pressure Solid Rectifier; Greenleaf Whittier Pickard, Amesbury, Mass. App. filed Sept. 15, 1909. Improvements.

1,257,531. Process for Making Catalyzers; William D. Richardson. App. filed Nov. 11, 1912. Improved method of hydrogenating oils or fats to harden or solidify them.

1,257,533. Electric Switch; Joseph Sachs, Hartford, Conn. App. filed Feb. 18, 1915. Used in conjunction with electromagnetic actuating mechanism.

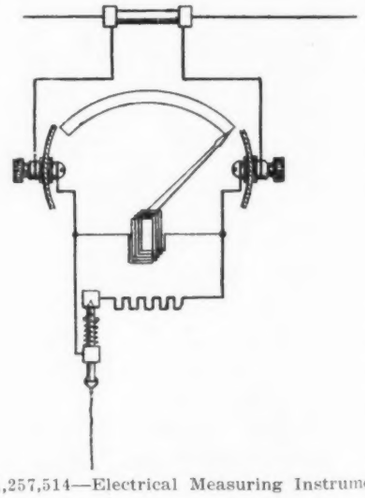
1,257,534. Switch; Joseph Sachs, Hartford, Conn. App. filed April 17, 1915. Pendent snap switch.

1,257,555. Method of Producing Analgesia; Frederick K. Vreeland, Montclair, N. J. App. filed June 25, 1914. By means of electric currents.

1,257,596. Pocket Hand-Lamp; Joseph C. Ford, Madison, Wis. App. filed May 17, 1917. A switch for connecting the battery and the electric bulb, located between the two.

1,257,599. Electric Heater; William S. Hadaway, Jr., New York, N. Y. App. filed Sept. 5, 1911. Electric heating element is embedded in the device.

1,257,615. Method and Means for Electrically Welding the Rims for Flanges of Wheel or Cycle Tires; Rudolf Kronenberg, Ohligs, Germany. App. filed Sept. 20, 1917. Full uniformity of welding.



1,257,514—Electrical Measuring Instrument

1,257,618. Electric Lighting System for Automobiles; Domnick F. Leone, Seattle, Wash. App. filed May 17, 1917. Improved controller and electrical connections.

1,257,646. Automobile Signal; Thomas E. Smith, Los Angeles, Cal. App. filed Jan. 8, 1917. Indicates the direction in which the automobile is to turn.

1,257,651. Line-Testing Instrument; Oscar F. Taliman and Fred E. Hubert, St. Louis, Mo. App. filed July 20, 1914. Compact and easily transportable.